ABSTRACT

Title of Dissertation: DISABILITY SERVICE USE AND ACADEMIC OUTCOMES FOR COLLEGE STUDENTS WITH DISABILITIES

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Despite the availability of disability support services, college students with disabilities continue to face poorer academic outcomes than their peers without disabilities. Over 70 percent of eligible college students with disabilities do not disclose their disability to their campus disability service to receive academic accommodations or supports. Among those who do utilize accommodations and supports, findings have been mixed regarding the relation between service use and students' academic outcomes. However, few studies have examined timing of registration with disability service and use of services over time. The current study used secondary data to examine the relation between time of disability service registration and length of accommodation use on the academic outcomes of undergraduate students with disabilities (*N*= 1,980) who used accommodations between fall 2015 and spring 2019. Descriptive analyses showed overall strong academic outcomes, with a mean GPA of 3.10 and a six-year graduation rate of 82.7 percent. Students delayed an average of 2.38 semesters before registering with the disability service and used their accommodations for an average of 3.23 semesters. Differences in academic outcomes and accommodation use patterns are discussed with regard to gender, race/ethnicity, and disability type. As hypothesized, multiple regression analyses revealed that

delayed registration with the disability service negatively predicted cumulative GPA and positively predicted time to graduation. Similarly, length of accommodation use positively predicted cumulative GPA and negatively predicted time to graduation. Results of the multilevel model regression with fixed effects showed that continued accommodation use positively predicted within-subject changes in students' semester GPAs across the eight semesters of the study period. Implications for future research and for improving service delivery for university disability offices are discussed.

DISABILITY SERVICE USE AND ACADEMIC OUTCOMES FOR COLLEGE STUDENTS WITH DISABILITIES

by

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1: INTRODUCTION

Over the past three decades, American colleges and universities have seen a marked increase in the numbers of students with disabilities participating in higher education. Nearly 32 percent of youth with disabilities enrolled in college in 2005, up from only 15 percent in 1987 (U.S. Department of Education, 2010). Students with reported disabilities now make up approximately 11 percent of the student body in American post-secondary settings (Raue & Lewis, 2011). Thus, it is vital for colleges and universities to ensure that students with disabilities can fully access resources on campus and have opportunities to succeed in the higher education environment.

Unfortunately, students with disabilities tend to face higher dropout rates and longer time to degree completion than their peers without disabilities (Koch, Lo, Mamiseishvili, Lee, & Hill, 2018; Murray, Goldstein, Nourse, & Edgar, 2000; Trammel, 2009). Some studies have also shown poorer academic outcomes, such as cumulative grade point average (GPA), among students with disabilities compared to peers without disabilities (e.g., Adams & Proctor, 2010; Richman, 2014). Researchers attribute these findings to barriers faced by students with disabilities that can inhibit academic success in college. Several key barriers include lack of knowledge of available supports, lack of self-advocacy skills, financial problems associated with disability-related expenses, and reluctance to disclose a disability due to stigma (Adler, 1999; Belch, 2004; Lightner, Kipps-Vaughan, Schulte, & Trice, 2012; Trammell, 2009). At the same time, higher education institutions also face challenges in adequately supporting students with disabilities. These challenges can include financial concerns, lack of faculty and staff knowledge surrounding disability issues, and poor coordination of disability services (Mamiseishvili & Koch, 2011).

Despite facing barriers at both the individual and institutional levels, students with disabilities can (and often do) succeed in higher education when provided with effective support and resources. Nearly all American colleges and universities report enrolling students with disabilities and are thus required to offer some form of disability-related support services to these students (Raue & Lewis, 2011). According to Dong and Lucas (2016), university disability service offices aim to "reduce or mitigate the academic or social obstacles encountered by students with disabilities in postsecondary education" (p. 48). This is accomplished through various supports and accommodations offered to students with disabilities who register with their campus disability service office. The most common services offered by disability service across the country include: Extended time on tests (93%), note taking assistance (77%), support with study skills (72%), alternate exam formats (e.g., oral or computerized exams; 71%), and use of adaptive technology (e.g., speech-to-text software or magnification devices; 70%; Raue & Lewis, 2011).

While such services are available to all students with documented disabilities, the majority of college students with disabilities do not disclose their disability to their school's disability service— and therefore do not receive available services. A national longitudinal study that monitored young adults with disabilities for eight years after high school found that only 28 percent of postsecondary students with disabilities disclosed their disability to their colleges, and only 19 percent received disability accommodations or supports in college (Newman et al., 2011). For students who do utilize disability service, the limited available research has been mixed regarding whether the use of accommodations is related to improved academic outcomes. Several studies have shown higher retention rates and GPAs among students with disabilities who use disability service compared to those who do not (Abreu, Hillier, Frye, Goldstein, 2016;

Mamiseishvili & Koch, 2011; Newman et al., 2015; Schreuer & Sachs, 2014). Meanwhile, other studies suggest that the use of disability service accommodations is not associated with improved academic outcomes (Lindsey, 2017; Lombardi, Murray, & Gerdes, 2012; Richman, 2014). Additional research has found that some services are more useful for students with specific types of disabilities than others. For instance, DuPaul and colleagues (2017) found that academic tutoring was most beneficial to students with learning disabilities (LD), while study skills coaching was most beneficial for students with Attention-Deficit/Hyperactivity Disorder (ADHD).

To date, research on factors related to postsecondary outcomes for students with disabilities has been extremely limited. More specifically, very few studies have examined the relation between use of disability support services and academic outcomes. The majority of the literature that does exist has focused only on college students with Attention-Deficit/Hyperactivity Disorder (ADHD) and/or learning disabilities (LD) and has not monitored the use of disability services over time. Further research is needed to determine whether existing accommodations and services offered by university disability service offices are adequately serving college students with disabilities. Thus, the current work aims to contribute to the literature base by investigating the impact of early registration and accommodation use over time on the academic outcomes of students with various types of disabilities.

Theoretical Framework

The current study is informed by theoretical models that aim to explain academic achievement, retention, and degree completion in higher education. As discussed by Attewell, Heil, and Reisel (2011), no single factor adequately predicts college success for all students. Because of this complexity, Tinto's (1975) interactionalist theory has reached "paradigmatic

stature" in the postsecondary retention literature (Braxton, Hirschy, & McClendon, 2004, p. 7). Tinto's model focuses on the ways that a student's personal characteristics interact with environmental factors to predict success in college. More specifically, Tinto identified three important and intertwined factors in student retention: Student characteristics (e.g., age, race, socioeconomic status, and academic history); academic and social engagement (e.g., participation in clubs and interactions with peers and professors); and institutional characteristics (e.g., institution type, size, location, and social norms). In more recent work, Tinto (1993, 2006, 2012) has argued that early integration into the institution's academic and social systems positively impacts college outcomes. A wide body of literature supports that involvement with peers and faculty both inside and outside of the classroom, particularly during a student's first year of college, is related to college retention (e.g., Bozick, 2007; Pascarella & Terenzini, 2005). Thus, students' experiences during the transition to college are crucial to social integration and eventual degree completion.

While Tinto's model portrays retention for students in higher education in general, other researchers have specifically examined retention frameworks for students with disabilities. Mamiseishvili and Koch (2011) found that disability-related characteristics, such as disability type, symptom severity, and disability-related services received, can impact students above and beyond other background characteristics from Tinto's (1975) model. For instance, individuals with sensory impairments (e.g., hearing or vision impairments) are more likely to enroll in four-year institutions compared to individuals with other disability types (e.g., LD, emotional disabilities, or other health impairments; Sanford et al., 2011). Another important disability-related characteristic is disability identity, which includes students' "attitudes about [their] disability and their comfort in revealing their disability status" (Mamiseishvili & Koch, 2011, p.

20). Research indicates that developing a positive, resilient disability identity can help offset the stigma associated with disabilities (Mpofu & Harley, 2006). On the other hand, denying or concealing a disability from others has been associated with negative outcomes, such as increased stress and decreased well being (Fitzgerald & Paterson, 1995).

There are also disability-related institutional factors that can help or hinder the success of students with disabilities on campus. Such factors include availability of transition programing (e.g., sessions during college orientation or introductory college courses explaining the process for obtaining disability service); campus accessibility for students with mobility needs; and the campus climate surrounding disability stigma (Lightner et al., 2012; Theodoto & Ressa, 2017). Many students with disabilities report discomfort around discussing their accommodations with instructors or using their accommodations in class due to a perceived shame surrounding having a disability or using services on campus. Professor attitudes and lack of knowledge about disabilities and accommodations can also contribute to negative campus climate and prevent students from being willing to seek disability service in college (Theodoto & Ressa, 2017).

In the current work, Tinto's (1975) interactionalist model provides the foundation for examining the impact of disability service on academic outcomes of college students with disabilities. Since this study examines students attending a single university, the findings will be interpreted within the context of that university's characteristics and social norms. Numerous individual factors, including demographic characteristics, previous educational experiences, and level of campus engagement, all play an important role in a student's preparation for and success in college. Given the importance of early integration into the college environment, we will examine the impact of early disability service registration and use of disability service use over time on students' academic outcomes. Finally, in light of recent work on disability-related

characteristics, we will consider the impact of available demographic variables (e.g., race and gender) and disability-related variables (e.g., disability type and specific accommodations used) on students' academic outcomes.

Organization of the Document

The proceeding research proposal is organized into three chapters. Chapter One introduced the importance of examining disability service for students with disabilities in higher education and described the theoretical framework of the study. Chapter Two includes a review of the historical context and relevant available literature that informs the current work. The research questions, methods, and analysis of the data are outlined in Chapter Three, and the results are presented in Chapter Four. Chapter Five includes a discussion of the findings and implications for future research and practice.

CHAPTER 2: LITERATURE REVIEW

The literature review for this work was obtained through a comprehensive search of multiple databases, including EBSCO Host, ERIC, SAGE, and Google Scholar. EBSCO Host was the primary database used. To determine relevance for the current work, studies were selected based on the following criteria: (a) the research focused primarily on undergraduate students; (b) the research assessed postsecondary outcomes and/or use of disability service for students with disabilities; and (c) the research was a published book, peer-reviewed article, published dissertation, or official research report (e.g., government-funded research studies). Though some international work was included, preference was given to studies that applied to higher education in the United States.

Before reviewing relevant research, it is important to establish the context in which the current work is situated. Thus, the subsequent sections discuss the historical and legal context surrounding disability supports in higher education in the U.S., and the theoretical paradigms related to academic success for postsecondary students with disabilities. The review then summarizes the existing research on this topic in order to establish the need for the current work to fill important gaps in the literature base.

Historical and Legal Context

The last half-century has involved striking changes to the rights and resources available to children and adults with disabilities in the United States. Prior to the 1970s, individuals with disabilities were not protected from discrimination or guaranteed equal rights under federal law. Children and adolescents with disabilities were often denied access to public education and placed into institutions or group homes (Davis, 2006). In 1973, Section 504 of the Rehabilitation Act prohibited discrimination against individuals with disabilities in federally funded programs,

including public schools. As the first disability civil rights law in the U.S., this act paved the way for students with disabilities to gain access to education at the primary, secondary, and postsecondary levels (Madaus, 2011). It also mandated that students with disabilities be granted access to reasonable accommodations in order to receive a "free and appropriate public education." Section 504 is now considered a "watershed moment in the development of supports for college students with disabilities," and it is credited with the "rapid growth of students with disabilities enrolling in postsecondary education" (Madaus et al., 2018, p. 133).

Section 504 opened the door for further legislation protecting the rights of individuals with disabilities in primary and secondary schools. The 1975 Education for All Handicapped Children Act, since renewed and renamed as the Individuals with Disabilities Education Act (IDEA), provided more specific guidelines regarding the types of programs, services, and accommodations available for students receiving special education services (Hudson, 2018). IDEA broadened the scope of special education to allow children and adolescents with disabilities to receive services from birth through high school graduation or age 21. It required schools to serve students in the least restrictive environment possible to accommodate their needs, which led to an increase in students with disabilities being included in general education classrooms whenever possible. Amendments were also added to emphasize transition planning, which has been cited as a reason for the increase in youth with disabilities enrolling in higher education over the past three decades (U.S. Department of Education, 2010).

After graduating high school or reaching age 22, individuals with disabilities are then protected under both Section 504 and the Americans with Disabilities Act of 1990 (ADA). The ADA is a civil rights legislation that prohibited discrimination based on disability and mandated equal access to many sectors of public life, including employment, transportation, public spaces,

and education (Hudson, 2018). It also extended protections for students with disabilities enrolled in both federally and non-federally funded educational institutions (Lam, 2017). Since the aforementioned laws define disability differently and mandate different procedures and responsibilities for individuals with disabilities, the following section will review major distinctions between the disability identification and service delivery processes at the primary/secondary and the postsecondary levels.

Distinctions Between Disability Laws

The IDEA, which covers children and youth prior to exiting high school, defines disability in terms of educational impact. To qualify for special education services, a child must have a disability that falls under at least one of 13 disability categories and that significantly impacts his or her educational or social functioning. Importantly, the IDEA places responsibility on the school to identify, assess, and provide services for students with disabilities. Once a child qualifies for special education services, the IDEA requires that schools create and monitor the goals of an Individualized Educational Plan (IEP) designed to promote the academic potential of that child. Accommodations and services at the primary and secondary levels can alter the educational program (if necessary) to maximize a student's success in school.

Several key distinctions exist once a student with a disability graduates high school and is protected by the ADA and Section 504. Whereas the IDEA requires that a disability have an educational impact, the ADA defines disability more broadly as an impairment that "substantially limits one or more major life activities" (Americans with Disabilities Act of 1990, 42 U.S.C. § 12101). Importantly, the ADA prohibits institutions from seeking information regarding students' disability statuses (Kim & Lee, 2016). This shifts the responsibility onto individuals with disabilities to obtain documentation, self-identify as having a disability, and

request eligible services (Hudson, 2018). Thus, upon entering college, students with disabilities must identify themselves to their campus disability service office, provide necessary documentation of their disability, and advocate for their need for specific services. Once registered with disability service, students are typically required to share their accommodations with their instructors each semester in order to implement their accommodations (Lam, 2017).

Another important distinction involves the goal of services provided in primary/secondary versus postsecondary settings. As mentioned above, the IDEA aims to monitor progress and modify a student's educational curriculum as needed to promote success. In contrast, the ADA and Section 504 focus on providing *access* to public settings (such as higher education); it does not require higher education institutions to monitor or guarantee a student's educational progress (Lovett, Nelson, & Lindstrom, 2014). In college, students with disabilities are afforded accommodations and services to "level the playing field," but they must complete the same educational program as their peers without disabilities. The differences highlighted above justify the emergence of a body of literature specific to studying disability and higher education, which will be described next.

Disability Studies and Current State of the Literature

As disability laws were passed and programs were put in place to support individuals with disabilities, the field of disability studies developed. Following the passage of Section 504, many universities established programs and services to support studies with disabilities on their campuses. Gradually, disability studies emerged as "a distinct field of practice and research in higher education" (Madaus et al., 2018, p. 134). A professional organization, currently known as the Association on Higher Education and Disability (AHEAD), was formed in 1978; the first peer-referenced journal in the field, *Disability Studies Quarterly*, began in 1986; and the first

disability studies program in the U.S. began at Syracuse University in 1994 (Lam, 2017). As the field has continued to grow in recent decades, several comprehensive reviews have attempted to capture the current state of the existing research related to disability studies in higher education.

Pena (2014) conducted a critical content analysis of articles published in four top-tier higher education journals from the passage of ADA in 1990 through 2010. During that time period, the four journals— *The Journal of Higher Education, The Review of Higher Education, Research in Higher Education,* and *The Journal of College Student Development*— published a total of 2,308 articles. However, only 25 articles, or 1% of the total, focused on students with disabilities. Additionally, 21 of the articles hailed from a single journal (*The Journal of College Student Development),* and the vast majority (22) were published during the 1990s. Pena acknowledged that more specialized journals on disability studies have emerged in recent years, which may partially explain the low publication numbers and time-related decline found in her work. However, it remains troubling that research on individuals with disabilities has been "largely invisible in the most privileged sources of research" in the larger higher education literature (Pena, 2014, p. 37).

While Pena's (2014) work paints a bleak picture, other reviews have portrayed the field of disability studies more holistically. Studies on students with disabilities in postsecondary settings have been published in hundreds of journals with distinct aims, audiences, and levels of rigor. Thus, Madaus et al. (2018) completed a comprehensive review of all available literature related to higher education and students with disabilities. The authors reviewed 1036 articles published in 233 journals between 1950 and 2012. Unlike Pena (2014), Madaus and colleagues reported an increase over time in the number of articles published on the topic, with nearly 80 percent of the articles published after 1995. This finding supports Pena's (2014) hypothesis that

disability-related articles are currently being published in a wide variety of journals, highlighting the importance of the large scope of Madaus et al.'s review. Four domains emerged as the overarching topics of the articles: Student-focused support, program and institution-level support, faculty and staff-focused support, and systems development. Notably, of the 615 studies that presented original data, more than 55 percent were descriptive quantitative articles. The majority of studies that reported disability information focused only on students with learning disabilities, and few studies provided comprehensive demographic information related to race, ethnicity, gender, and class standing. Because the current literature base is largely descriptive in nature, Madaus et al. (2018) concluded:

> There is a dearth of literature about empirically validated methods related to teaching, or support for students with disabilities […] At this time, we cannot point to many practices that we can say with confidence will result in college matriculation, retention, or graduation for students with disabilities (p. 142).

A third review, conducted by Kutscher and Tuckwiller (2018), focused more specifically on studies examining factors related to postsecondary persistence for students with disabilities. Their mixed systematic review identified 16 qualitative articles and 10 quantitative articles published between 1990 and 2017. Factors related to college persistence across the articles included student characteristics (self-awareness, self-efficacy, empowerment/perseverance, and self-advocacy); academic and social engagement (faculty interactions, peer interactions, disability-specific social support, family/off-campus support); and disability accommodations (awareness of accommodations, use of accommodations, quality of accommodations, and match between accommodations and individualized needs). Importantly, the authors reviewed the studies for quality based on standards established by the National Technical Assistance Center on Transition (NTACT). Unfortunately, only seven of the quantitative studies, and none of the qualitative studies, met the "acceptable quality" criteria. The authors also did not have sufficient

data to examine how the identified factors differ across disability-related or demographic characteristics. Thus, while the available literature can be considered a preliminary starting point, there is an overall "paucity of research" on factors related to postsecondary success for students with disabilities (Kutscher & Tuckwiller, 2018, p. 138).

Disability Services in Higher Education

Having provided an overarching description of the limited state of the current literature base, we turn to a review of the available literature on disability services at postsecondary institutions. These sections highlight the demographic and academic profile of postsecondary students with disabilities, the types and prevalence of disability service in American colleges and universities, and the mixed findings regarding the impact of disability service use on academic outcomes for students with disabilities.

Profile of Students with Disabilities in Higher Education

As mentioned above, higher education institutions are prohibited from inquiring about students' disability statuses, and the majority of students with disabilities do not self-identify to their universities (Newman & Madaus, 2015b). Therefore, it has historically been difficult for both institutions and researchers to obtain an accurate profile of students with disabilities on college campuses nationwide. Beginning in the year 2000, the U.S. Department of Education funded the National Longitudinal Transition Study-2 (NLTS2) in order to provide information on a nationally representative sample of over 11,000 postsecondary students with disabilities (Newman et al., 2011). The study was an update to the original NLTS study, which had included only students with learning disabilities. For the NLTS2, researchers monitored high school students with disabilities receiving special education services for eight years following graduation using surveys and interviews with both students and their parents. This allowed the

researchers to monitor outcomes of students who did and did not pursue higher education, and students who did and did not disclose their disability to their college disability service.

The NLTS2 study revealed a comprehensive profile of the demographic characteristics of students with disabilities pursuing higher education. Over the course of the study, approximately 60 percent of the students pursued some type of higher education (Newman et al., 2011). Of participants with disabilities who pursued higher education, 44 percent attended a 2-year institution, 32 percent attended a technical school, and 19 percent attended a 4-year institution. Postsecondary enrollment was more common among students with LD, speech/hearing/visual impairments, and other health impairments (including ADHD) compared to students with Autism Spectrum Disorders, psychiatric disabilities, intellectual disabilities, or multiple disabilities. Students with disabilities who pursued higher education did not vary by gender, race or ethnicity. Participants from higher income families were more likely than others to have enrolled in 2-year institutions, but there were no family income differences in enrollment in technical or 4-year institutions. The profile of student use of specific disability services from the NLTS2 will be discussed further in the "Prevalence of student disability service use" section below.

Academic outcomes of students with disabilities in higher education. Once enrolled in higher education, studies have shown that students with disabilities tend to have poorer academic outcomes compared to students without disabilities. Much of the existing research has been conducted with students with LD and/or ADHD; these studies show that students with these disability types tend to enter college later, have lower GPAs, and graduate at lower rates than their peers without disabilities (Koch et al., 2018; Murray et al., 2000; Trammel, 2009; Richman, 2014). For example, a large archival study of university students in Canada revealed that students with LD and/or ADHD were more likely to be placed on academic probation and less likely to

continue enrollment through the end of their second year than other students (Dong & Lucas, 2016). Recent work by Koch and colleagues (2018) examined dropout rates of over 7,700 American college students from the Beginning Postsecondary Students (BPS) Longitudinal Study. Students with disabilities in their sample reported higher levels of academic and social integration (measured by self-report of interactions with students and faculty outside of class and involvement in extra-curricular or social activities) than peers without disabilities, which typically would be associated with college success. Nonetheless, students with disabilities still had higher risk of college dropout than their counterparts without disabilities. Richman (2014) also found lower GPAs and longer time to degree completion among students with LD and/or ADHD compared to a matched sample of students without disabilities. Among a survey sample of undergraduates with varying disability types, Coduti, Hayes, Locke, & Youn (2016) showed that students with disabilities report more anxiety, academic distress, suicidal ideation, suicide attempts, and nonsuicidal self-injury compared to students without disabilities. Thus, the majority of the literature confirms that students with these disability types disproportionally struggle to succeed in college.

More recently, two studies examining the broader population of students with disabilities have shown that students with disabilities often graduate at similar rates to their peers without disabilities—they just tend to take more time to graduate. Wessel, Jones, Markle, and Westfall (2009) found that students with non-visible disabilities (such as learning disabilities) had lower four-year graduation rates than students with visible disabilities (such as physical disabilities) or students without disabilities. However, by year six, all students were equally likely to have graduated. Knight, Wessel, and Markle (2018) recently replicated this finding among another sample of over 32,000 university students. Students with disabilities on average took

significantly longer to graduate than students without disabilities, but they were equally as likely to have graduated within six years. Importantly, both of these studies took place at a university described as going "above and beyond the mandates" of disability laws in providing services for students with disabilities (Knight et al., 2018, pp. 367). This included free tutoring and degree progress monitoring sessions for all students, a modified residence hall for students with disabilities, and campus-wide disability awareness programs and trainings. Additionally, participants categorized as having disabilities in the studies had all disclosed their disabilities to the school disability service within the first semester of matriculating. Thus, these findings may not generalize to other colleges and universities nationwide or to students who disclose their disability later in college.

Types of Disability Services Offered in Higher Education

For students who choose to disclose their disability, several types of supports are available to individuals with disabilities in higher education settings. McLaughlin (2012) distinguished between *accommodations*, which provide equal access to instruction without altering the content or academic expectations, and *modifications*, which change the content or academic expectations for the individual with a disability. For example, extended time on tests is an accommodation that requires students to complete the same academic material within an altered time frame. In contrast, a spelling test with lower-level (or higher-level) words is a modification that alters the content the individual is expected to learn. While curriculum modifications are common for children receiving special education services in the k-12 environment, postsecondary settings typically do not offer services that alter the standards of an academic program. This is because the ADA focuses on providing access to the educational environment and does not guarantee meaningful educational progress (Lovett, Nelson, &

Lindstrom, 2014). Among the NLTS2 sample, 59% of participants had received at least one modification in high school, yet only 4% did so in college. Since modifications are not common in higher education institutions, we focus below on types of accommodations and other services available to students with disabilities in most college and universities across the country.

As discussed above, college students with disabilities must self-identify to their campus disability service office as a student with a disability in order to receive services and accommodations. Once registered with disability service, students have access to a variety of accommodations and services intended to promote equal access to the college education setting. Mull, Sitlington, & Alper (2001) conducted a meta-analysis of 26 studies examining postsecondary services for college students with LD and ADHD published between 1985 and 2000. Their findings revealed three overarching types of accommodations: Program accommodations, support services, and instructional adjustments. Program accommodations are institution- or department-level changes to the student's academic plan. Examples include priority registration, allowance of reduced course load or additional time to complete courses, course substitutions or waivers, and late class withdrawal. Support services are specific "features, supports, or services provided for students with disabilities" (Newman & Madaus, 2015a, p. 176). Support services offered by many institutions include assistance with study skills, time management and organization strategies, test taking strategies, tutoring, academic advising, and personal counseling. Finally, instructional adjustments (more commonly called academic accommodations) involve changes to lecture or testing situations. Examples of instructional adjustments include test accommodations (such as extended time or reduced distraction test environments), use of assistive technology (e.g., screen readers) during class or tests, and note-taking assistance.

More recently, Barber (2012) provided an updated view of the types of disability service offered by American post-secondary institutions. During the 2008-2009 academic year, 88 percent of 2- and 4-year institutions enrolled students with disabilities, including over 99 percent of public institutions. Of those institutions, 93 percent provided students with disabilities with extended time on tests; 77 percent provided note takers; 72 percent provided study skill assistance; 71 percent provided alternative exam formats; and 70 percent provided adaptive technology services. While individual institutions vary, these findings are consistent with the National Center for Education Statistics' report of the most common types of accommodations offered by disability service offices nationwide (Raue & Lewis, 2011). They also mirror self-report data from postsecondary students in the NLTS2 study (Newman et al., 2011) about the specific accommodations utilized in college, with some of the most common being additional time on tests (79%), adaptive technology such as screen readers (37%), tutors (37%), learning or behavior management support (23%), additional time for assignments (23%), and note takers (17%).

The analyses of the current work focus mainly on the use of academic accommodations, since tutoring and counseling services are offered through offices other than the disability service office at the university. However, for the purposes of the literature review, the terms "accommodations," "services," and "supports" will be used interchangeably to signify the various resources available to students with disabilities in higher education settings. This decision is consistent with previous reviews (e.g., Lam, 2017). Additionally, universities have varying names for their campus Disability Support Service office (e.g., Accessibility and Disability Service; Office of Disability Support), but we will refer to these offices as disability services for consistency across studies.

Prevalence of Student Disability Service Use

Colleges and universities are required by law to provide appropriate services and supports to students with disabilities who disclose their disability to disability service. Unfortunately, research suggests that the majority of eligible students do not seek out or receive such services. The NLTS2 study found that only 28 percent of postsecondary students with disabilities disclosed their disability to their school (Newman et al., 2011). Therefore, even though all students in the NLTS2 sample received special education services in high school, only 19 percent received any disability-related services in college. Interestingly, students with hearing, visual, or orthopedic impairments were more likely to receive accommodations than students with LD or other health impairments. Similarly, survey data from another large study revealed that relatively small percentages of students with cognitive disabilities (32%), psychological disabilities (12%), and physical disabilities (9%) requested accommodations during their first 2 years of college (Dong & Lucas, 2016). Because most eligible students do not seek out accommodations in college, campus disability service offices are not able to provide services to many students with disabilities who could benefit from disability service.

Studies examining reasons for low disability service use. Researchers have proposed several reasons to explain why so many individuals with disabilities choose not to disclose their disabilities to disability service offices in college. One explanation, self-determination, is defined as an individual's decisions about their disability-related needs (Eckes & Ochoa, 2005). Some college-bound students may determine that they no longer need disability accommodations or no longer consider themselves to have a disability. In the NLTS2 sample, 63 percent of participants did not consider themselves to be a person with a disability upon entering college (Newman et al., 2011). While this may reflect remediated symptoms or learned strategies to overcome the

impact of a disability, researchers have cautioned that students may lack knowledge or awareness of their specific disability and its impact on their learning (Lightner et al., 2012; Newman & Madaus, 2015a). A survey of 110 college students with LD revealed that 91 percent of participants did not recall having an IEP in high school, even though 95 percent of the participants received special education services in high school for which an IEP would have been established (Cawthorn & Cole, 2010). Similarly, Lightner and colleagues (2012) interviewed 42 college students with LD about their decision to seek accommodations in college. Many participants cited lack of knowledge about their disability and their need for services at the college level as a reason for delaying service use. In fact, over 80% of students waited to seek accommodations until they experienced an academic crisis. While this sample was small, the findings suggest an overall lack of knowledge about the impact of disabilities and students' need for services in college, which has been corroborated by other work (e.g., Salzer, Wick, & Rogers, 2008).

In this vein, another potential reason for low disclosure rates among college students with disabilities involves a lack of transition planning and preparation for the level of independence required to access disability service in college. A substantial body of literature has highlighted the importance of transition planning services for students with disabilities. Among Lightner et al.'s (2012) sample, participants who registered with disability service during their first semester of college were more likely to report receiving transition services in high school than those who registered later. Consistent with prior qualitative work (e.g., Kurth & Mellard, 2006), many students described a lack of knowledge about college disability procedures and the resources available to them on campus. In Cawthorn & Cole's (2010) sample, nearly half of participants reported receiving no guidance about what accommodations they needed in college or how to

establish accommodations with their campus disability service. Given these findings, it is not surprising that students with disabilities entering postsecondary institutions frequently struggle with the heightened level of independence required of them to seek out and implement accommodations. Researchers have called for improved transition services in both high school and college settings to assist students with disabilities to bridge this gap to independence (Stennis Moore, 2017; Knight et al., 2018).

Finally, the stigma surrounding disabilities and disability services prevents many students from disclosing their disability and registering with disability service. Research suggests that stigma is particularly burdensome for individuals with non-visible disabilities, such as LD, ADHD, and psychiatric disabilities. For instance, students with LD report fears that faculty will question their academic abilities (Denhart, 2008) or that peers will view them as cheating (May & Stone, 2010) if they disclose their disability and request to use accommodations. A study of British college students revealed that the majority of students with psychiatric disabilities also chose not to disclose their disability to their school due to concerns about stigma and discrimination (Martin, 2010). Since colleges require students to initiate service provision by disclosing their disability, stigma presents a significant obstacle that inhibits many students from seeking necessary services.

Relation Between Disability Service Use and Academic Outcomes

Further efforts are needed to reduce the barriers preventing students from accessing and using disability service in college. However, an equally pressing concern involves whether students who do register for disability service benefit from such services. A chief purpose of disability service is to "level the playing field" in order to mitigate the academic challenges often faced by students with disabilities (Knight, Wessel, & Markle, 2018, p. 365). Despite strong

intentions, campus disability service offices face many challenges in reaching their intended population. As described above, it is known that the majority of college students with disabilities do not register with disability service offices to receive services. If students with disabilities were aware of the services available to them and the ways they could benefit from such services, it is likely that higher numbers of students would register for disability service. Thus, a crucial question that remains unanswered in the current literature is whether use of disability services and accommodations is related to improved academic outcomes for college students with disabilities. In fact, Schreuer and Sachs (2014) described the topic as a "subject of international debate" (p. 29). However, very few studies have examined this question to date, with many researchers criticizing the scarcity of existing work on the topic (Kim & Lee, 2016; Kutscher & Tuckwiller, Madaus et al., 2018). The following section outlines the available research to highlight the mixed findings on the relation between use of disability service and postsecondary academic outcomes.

Studies reporting positive association of disability service use and academic outcomes. Among the existing literature, several studies have reported positive associations between use of disability service in college and academic outcomes. Schreuer and Sachs (2014) asked university students in Israel with physical, sensory (e.g., hearing or vision), or psychiatric disabilities to report their use of specific types of disability-related supports using the Physical, Human, and Academic Accommodation Services (PHAAS) scale developed for the study. Disability service use was associated with significantly higher GPAs and levels of participation in campus academic and social activities. It should be noted that this study was conducted in Israel with a relatively small sample size (N= 170), so the results may not parallel the experiences of American college students. In the U.S., Dong and Lucas (2016) found that

students with cognitive or psychological disabilities were more likely to be in good academic standing (i.e., not on academic probation or dismissed) after three semesters of college if they had registered for accommodations. By using an online survey to compare students who did and did not register for accommodations across time, this study provides strong evidence for the academic benefits of accommodation use.

Other researchers have found similarly positive relationships between GPA and the use of academic accommodations and support services. For example, Kim and Lee (2016) examined the impact of test accommodations and course accommodations on the GPAs of 1248 students registered with the disability service office of a large research university. They found that use of test accommodations significantly predicted cumulative GPA above and beyond demographic and disability factors. Specifically, extended time on tests and physical test location accommodations had the strongest effect on GPA (though the beta weights were still small). Course accommodations, such as extensions on assignments or note taking assistance, significantly predicted GPA but did not improve the model when demographic and disability factors were taken into account. Meanwhile, DuPaul et al. (2017) showed the benefits of other support services, such as tutoring and coaching, for students with certain disabilities. Specifically, students with ADHD showed significant gains in GPA when using study skill coaching, and students with learning disabilities showed significant gains in GPA when using tutoring resources. Troiano, Liefield, and Trachtenberg (2010) also found that use of the academic support center was associated with higher GPAs and graduation rates among college students with LD. Thus, it is important to investigate disability support services individually based on their effectiveness for students with specific disability types.

While cumulative GPA is an important and common marker of student academic achievement, other studies have utilized persistence or retention rates, which have been shown to predict eventual graduation (Tinto, 1993). Mamiseishvili and Koch (2011) investigated factors that influence first-to-second-year persistence for a subset of students with disabilities from the BPS study described earlier. Consistent with Tinto's (1975) interactionalist theory, background variables (e.g., full-time status, first year GPA), disability variables (e.g., type of disability), and college variables (e.g., price of attendance) were important predictors of student persistence. Use of specific accommodations—such as readers, note takers, and course substitutions/waivers—also had a small but significant association with persistence. Since this study only examined first-to-second-year persistence, it did not capture the potential impact of disability service accommodations throughout a student's entire college career. A longer-term archival study examined graduation rates, disability services, and student characteristics of students with disabilities across three public universities (Pingry O'Neill, Markward, & French, 2012). Females and students with physical disabilities (compared to those with cognitive or psychological disabilities) were more likely to have graduated. Approval for specific disability accommodations, such as alternate format of tests, reduced-distraction testing, learning/study skill support, and flexible due dates, was also associated with increased graduation rates. Both of these studies suggest that accommodation use plays a role along with other background and college variables in predicting student success in college.

Qualitatively, a small body of work has shown positive perceptions of disability service use for students with disabilities. Through interviews with 12 students with disabilities registered with the campus disability service, Yssel, Pak, & Beilke (2016) found an overall positive campus climate surrounding disability accommodations, and most students discussed benefits of having

access to accommodations in college. Similarly, a dissertation study by French (2013) utilized open-ended surveys of 169 undergraduates with disabilities across several private colleges. The majority (66%) indicated overall positive perceptions regarding the disability services they received in college. Additionally, 77 percent of participants reported that accommodations and support from campus disability services contributed to their progress toward degree completion. Abreu, Hillier, Frye, and Goldstein (2016) asked students with disabilities to rate the usefulness of specific accommodations, with extended time on tests, reduced distraction test taking, and audio recording of lectures emerging as the most useful accommodations for students. Eighty-five percent of participants reported that the disability service office was useful for their academic success in college. While student perceptions do not necessarily mirror actual academic benefit, it is important for researchers to consider student beliefs and experiences in examining the effectiveness of disability support services. A particular strength of Abreu et al.'s study was the longitudinal analysis of student visits to the disability service office and student GPA. Students visited the disability service an average of 4.7 times per semester, mainly to establish or alter accommodations. Importantly, the researchers found a positive relationship between number of visits and cumulative GPA, suggesting that students' positive perceptions mirrored a degree of actual benefit toward academic success.

Studies reporting limited association of disability service use and academic outcomes. Although a growing body of research suggests a positive association between use of disability services and students' academic outcomes, other studies challenge this relationship. Specifically, a number of researchers have questioned the efficacy of testing accommodations, one of the most common types of accommodations in postsecondary settings. The intended purpose of test accommodations, like all accommodations, is to ensure equal access to test items

in order to more accurately measure the abilities of students with disabilities. If a given test accommodation is valid, it should improve the test performance of individuals with disabilities more than the performance of individuals without disabilities; this effect has been called the "interaction hypothesis" (Sireci, Scarpati, & Li, 2005). While some older studies have supported the interaction hypothesis, particularly for students with learning disabilities (e.g., Alster, 1997; Runyan, 1991), more recent studies have questioned the efficacy of test accommodations for students with specific disability types.

For example, several small experimental designs suggest that students with LD do not consistently show improved test scores under extended time conditions or with alternate exam formats (Lindsey, 2017), and that students without disabilities tend to benefit more from extra time than students with LD (Lewandowski, Cohen, & Lovvett, 2013). In Lewandowski et al.'s (2013) study, the performance gap between participants with and without LD widened with increased time, favoring participants without disabilities. However, when only participants with LD were given extended time, especially double time, they often outperformed their peers without disabilities. Among students with ADHD, an experimental study of reading comprehension showed that participants with and without ADHD performed similarly in both the number of items attempted and items correct across standard, time and a half, and double time conditions (Miller, Lewandowski, & Antshel, 2015). Consistent with Lewandowski et al.'s finding, when comparing the ADHD group with extended time to the control group with standard time, the ADHD group attempted and correctly answered significantly more questions. This suggests that extended time may provide an undue advantage for some students with disabilities. Another study from this group of researchers also found that the efficacy of extended time may differ not only by disability type, but also by symptom level: Lovett and Leja (2015)

found that participants who self-reported higher levels of ADHD symptoms and executive functioning deficits benefited less from extended time than other participants with ADHD. Unfortunately, most of the existing studies on test accommodations have focused only on students with LD or ADHD, so the benefits are unknown for students with other types of disabilities. The use of small experimental designs also may not generalize to the use of test accommodations in higher-stakes, real-life settings. Based on a comprehensive review of the limited available literature, Sireci and colleagues (2005) concluded that "consistent conclusions were not found across studies" to confirm the effectiveness of test accommodations specifically for students with disabilities (p. 456).

In addition to test accommodations, other studies have questioned the impact of disability services more broadly. Richman (2014) analyzed academic outcomes among a large sample of college students with LD and/or ADHD. Participants were categorized into one of three groups according to their use of disability-related services: no services, accommodations-only, and accommodations plus support services (e.g., sessions with a learning specialist). Students who used accommodations-only took significantly longer to graduate than students who used accommodations plus support services. However, students who used no disability services had comparable GPAs, withdrawal rates, and graduation rates to students who used accommodations plus support services. While it is possible that students in the no services group had less need for such services in order to succeed in college, the findings cast some doubt onto the efficacy of disability service. This is particularly concerning given that the use of academic accommodations alone did not appear to help students in this sample academically.

Given the prior emphasis on students with LD and ADHD, Lombardi, Murray, and Gerdes (2012) aimed to extend the literature by investigating disability-service use among first-

generation and continuing-generation college students with multiple types of disabilities. Findings indicated that first-generation participants had lower GPAs, but were more likely to report using accommodations, than their continuing-generation peers. However, use of accommodations was not associated with improved GPAs. The authors discussed background and college factors (such as financial stressors and reduced peer and family support) that may have contributed to the lower GPAs among some first-generation participants. Similarly, Cawthon, Leppo, Ge, and Bond (2015) utilized a subset of the NLTS2 data to examine accommodation use and academic outcomes for college students who are Deaf or Hard of Hearing. After taking demographic factors into account, postsecondary accommodation use did not predict student retention or degree completion. Students who were Caucasian, students from higher income families, and students with other co-occurring disabilities were more likely than other participants to use specific types of accommodations in college. Lombardi et al.'s and Cawthon et al.'s studies are important in examining a variety of background, college, and disability service-related variables among students with previously under-examined disability types. When considering the complex interaction of these variables together, use of accommodations did not significantly improve students' academic outcomes.

Conclusions Regarding Mixed Findings

As shown above, the current literature base shows mixed findings regarding whether use of specific accommodations, and disability services more broadly, is related to postsecondary academic success. The following section will summarize conclusions that can be drawn from the inconsistent results that were found in this literature review.

First, it should be emphasized again that the overall body of literature on the effectiveness of postsecondary disability accommodations is extremely small and of limited

rigor. In their systematic mixed-methods review, Kutscher and Tuckwiller (2018) found only 16 qualitative articles and 10 quantitative articles published between 1990 and 2017 on the subject of postsecondary persistence for students with disabilities. While Madaus et al. (2018) reviewed a broader scope of articles related to students with disabilities in higher education, the researchers found that the majority of articles were descriptive rather than empirical and lacked rigorous methodologies. As summarized by Kutscher and Tuckwiller, we have a good understanding of "*what is* currently occurring or experienced" by students with disabilities, but "there is a need to better understand *what works* for students with disabilities in postsecondary settings" (p. 136).

In closely analyzing the existing studies, those showing a positive relationship between disability service use and academic outcomes are methodologically stronger overall than those showing a null relationship. More specifically, more of the studies suggesting associated benefits of disability service (e.g., Kim & Lee, 2016; Mamiseishvili & Koch, 2011; Pingry O'Neill et al., 2012) utilized large sample sizes of students with a variety of disability types and considered the impact of demographic/ student level factors. Several also followed students longitudinally to show potential benefits of service use over time (Dong & Lucas, 2016; DuPaul et al., 2017; Mamiseishvili & Koch, 2011; Troiano et al., 2010; Pingry O'Neill et al., 2012). In contrast, the majority of studies finding no benefit of accommodations, particularly test accommodations, have been small in-vitro experimental studies with students with LD/ADHD; these studies likely do not mirror the actual experiences of most college students with disabilities. Only two of the studies showing no relation between accommodation use and academic outcomes involved students with other disability types (Cawthon et al., 2015 and Lombardi et al., 2012); both of these studies involved a specific sub-population of students (students who are deaf/hard of

hearing and first-generation college students with disabilities), rather than the broader population of students with many different disability types. In sum, while the overall literature base is inconsistent, there is stronger evidence for the benefits of disability services for college students with disabilities compared to the drawbacks of such services.

Impact of time of disability service registration and length of service use.. Emerging work suggests that timing of disability service registration, and use of disability services over time, may play a key role in predicting college success for students with disabilities. A recent longitudinal study by Hudson (2018) evaluated the impact of time of disability service registration on graduation rates of students with (*N*=423) and without (*N*= 13,978) disabilities at a single university. Overall, students with disabilities had significantly lower six-year graduation rates (69.5%) than their peers without disabilities (79.7%). However, students with disabilities who disclosed their disability to disability service in their first year of college were significantly more likely to graduate within six years (85%) than those who disclosed after their first year (48%). On average, students with disabilities took over 1.5 years to register with disability service after entering college. For each year a student waited to register with disability service, their length of time to graduation increased by nearly six months. This study confirmed the findings of a smaller, mixed-methods study indicating that students who sought disability services earlier in college tend to perform better academically (Lightner et al., 2012). Hudson's work is one of the strongest empirical studies to date in longitudinally showing the association between early registration and academic outcomes. Other work has shown that increased contact with disability support staff is related to improved academic outcomes over time (Abreu et al., 2016; DuPaul et al., 2017; Richman, 2014). Thus, timing of registration and length of service use is an important and previously unstudied factor in the postsecondary disability service literature.

Gaps in the Current Literature

Given the overall dearth of studies and the existence of mixed findings, several gaps in the literature warrant discussion. One limitation of many of the above studies, including Hudson's (2018), is that they rely on students' registration with their campus disability service office as a proxy variable for accommodation use. Unfortunately, many students who disclose their disability and establish accommodations with disability service never actually utilize their accommodations, or they do so inconsistently. Richman (2014) found that one-third of participants never returned to the disability service office to set up their accommodations after their initial intake meeting. In other words, "the existence of accommodations is important but not sufficient for their uptake" (Schreuer & Sachs, 2014, p. 29).

To date, very few studies have examined students' use of accommodations and services over time. Several researchers have tracked the number of times students meet with support services, showing that meetings with learning specialists, tutors, and disability service staff (Abreu et al., 2016, DuPaul et al., 2017; Richman, 2014) are positively related to GPA and graduation rates. However, disability service visits is not an adequate measure of student accommodation use. Procedures vary at individual universities, but typically students return to meet with disability service staff only if they are experiencing difficulties (for instance, if they want to modify their accommodations or need help implementing their accommodations). Students who are using their accommodations without issue may not return, and would not be accurately measured in these analyses. The author was unable to locate any longitudinal studies that have tracked both students' use of academic accommodations and their academic outcomes over time. Thus, the existing research has not been able to sufficiently monitor whether students

actually use their accommodations over the course of their university careers, which is crucial to determining the effectiveness of the established accommodations.

Relatedly, most studies have examined the relationship between disability service use and academic outcomes at a single point in time. This method captures students who established accommodations as soon as they entered university alongside students who registered in their final semester (and the rest of the spectrum in between). If accommodations are indeed effective, using them for a longer period of time would be expected to benefit students the most. Researchers who have used longitudinal approaches (e.g., Dong & Lucas, 2016; Mamiseishvili & Koch, 2011; Richman, 2014) have not taken time of registration or actual accommodation use into account. While Hudson (2018) examined time of registration, she did not analyze the use of specific accommodations and was unable to determine whether students continued implementing their accommodations beyond the time of disability service registration. In order to accurately determine whether accommodations benefit students, it is necessary to evaluate students' academic outcomes based on their cumulative use of academic accommodations over time.

Another important consideration that has not received adequate empirical attention is the varying needs of students based on disability type. Individuals with different disability types often require different accommodations in order to access the educational environment. For instance, some accommodations (e.g., sign language interpreters or wheelchair accessible desks) are only appropriate for and used by students with specific disability types. Studies by Mamiseishvili and Koch (2011) and Kim and Lee (2016) described accommodations approved for students of various disability types, but they did not test for differences in accommodation use across disability types. Dong and Lucas (2016) also showed differences in the effectiveness of accommodations for students with different disabilities, though their work did not explore

specific accommodation types. The majority of other studies to date have focused specifically on accommodations for students with LD and/or ADHD or have not broken down their findings by disability type. LD and ADHD are two of the most common diagnoses among postsecondary students and are generally considered to be lifelong diagnoses due to their neurological basis (American Psychiatric Association, 2013). However, individuals with many other types of disabilities enroll in American colleges and universities and have unique needs that are currently understudied. Unlike LD or ADHD, most psychiatric/psychological disabilities (such as anxiety or depression) have an average age of onset in adolescence or early adulthood (American Psychiatric Association, 2013). Therefore, some individuals are diagnosed with a psychological disability for the first time while in college. It is important to take disability type into account when analyzing time of disability service registration, since students who are diagnosed later in college would not register with disability service until after they are diagnosed. More studies are needed that examine the use and potential benefit of accommodations based on the individual needs of students with various types of disabilities. As summarized by Fletcher et al. (2006):

> Perhaps the most consistent finding reported across studies and reviews examining accommodations for students with disabilities is the observation that the students are heterogeneous. Simply defining students as learning disabled or as "students with a disability" without considering the area of academic disability may dilute the effect of an accommodation. The accommodation should be specific to the type of academic disability (p. 138).

Relatedly, almost no studies have examined the potential role of student demographic characteristics in the relation between accommodation use and postsecondary academic outcomes. It is known that adults with disabilities from racial and ethnic minority backgrounds are less likely to seek and receive physical and mental health services than White adults with disabilities (Gulley, Rasch, & Chan, 2014; Harrington & Kang, 2008). It is also well documented that females tend to seek help for mental health problems more frequently than males (Hammer

& Vogel, 2010; Yousaf, Popat, & Hunter, 2014), and they graduate college at higher rates than males (Pingry-O'Neill et al., 2010, Wessell et al., 2009). Among college students in the NLTS-2 study, rates of disability disclosure to the campus disability service and the receipt of accommodations did not differ based on race, ethnicity, gender, or socioeconomic status (Newman et al., 2011). However, Newman and colleagues did not examine the association between actual service use and academic success among students. Several studies have controlled for race, gender, or disability type in their analyses (e.g., Kim & Lee, 2016; Mamiseishvili & Koch, 2011) but have not broken down accommodation use or academic outcomes based on individual characteristics. Hudson's (2018) work is the only known study to do so, showing that males with disabilities took slightly but significantly longer to graduate than females with disabilities, even when considering the significant effect of time of registration with disability service. Unfortunately, Hudson did not include race as a predictor in her analyses. Thus, more research is needed that more fully captures the accommodation use patterns and outcomes of all students with disabilities attending American postsecondary schools.

Current Study

The primary goal of the current study is to address some of these crucial gaps in the existing literature regarding the relationship between accommodation use and academic outcomes of college students with disabilities. While researchers previously could not feasibly track actual accommodation use for large numbers of students over time, recent technological advances have allowed for a more accurate method of tracking these data. More specifically, many disability service offices across the country have begun utilizing electronic client management systems to store intake information, documentation, and accommodation lists. In order to use their accommodations, students at many universities must now download an

accommodation letter to share with their instructors each semester; this action becomes automatically documented in the client management system. Several studies have utilized disability service electronic databases to obtain information regarding accommodation use cross-sectionally (e.g., Kim & Lee, 2016; Lombardi et al., 2012). The author is aware of only two longitudinal studies that utilized electronic database systems, each of which have important limitations. As mentioned above, Hudson (2018) examined the impact of registration time, but actual accommodation use post-registration was not assessed. Likewise, Richman (2014) used number of meetings with a learning specialist as a proxy variable for service use but did not analyze academic accommodation use over time. Her study also focused on a sample of students with only LD or ADHD, which does not represent the needs of students with other disability types.

To the author's knowledge, this study is the first to take advantage of the electronic tracking of students downloading their accommodation letter each semester in order to more accurately measure use of academic accommodations throughout college. This methodology allows us to assess whether length of accommodation use is related to better academic outcomes longitudinally. Using this approach, we aim to extend prior work suggesting that increased involvement with the campus disability service is related to gains in GPA over time (DuPaul et al., 2017; Troiano et al., 2010). Additionally, our work aims to further Hudson's (2018) finding that earlier registration with the disability service office is associated with more positive academic outcomes. Consistent with Tinto's (1975) interactionalist framework, the large sample size permits us to take demographic and disability-related variables into account to provide a comprehensive picture of the impact of accommodation use on academic outcomes for students registered with the University of Maryland Accessibility and Disability Service (ADS).

Research Questions and Hypotheses

1. Descriptive Research Question: What are the specific accommodation use patterns and academic outcomes of ADS students based on primary disability type, race/ethnicity, and gender?
2. Does delayed registration with ADS predict cumulative GPA and time to graduation, controlling for disability type and demographic characteristics?
    a. **Hypothesis 2a:** Delayed registration with ADS will negatively predict cumulative GPA.
    b. **Hypothesis 2b:** Delayed registration with ADS will positively predict time to graduation among students who have graduated.
3. Does length of accommodation use predict student GPA and time to graduation, controlling for disability type and demographic characteristics?
    a. **Hypothesis 3a:** Length of accommodation use will positively predict cumulative GPA.
    b. **Hypothesis 3b:** Length of accommodation use will negatively predict time to graduation among students who have graduated.
4. Does accommodation use over time predict within-subject changes in GPA?
    a. **Hypothesis 4:** Each semester of accommodation use will positively predict within-subject changes in semester GPA over time.

CHAPTER 3: METHODS

The current study examines the impact of accommodation use on the academic outcomes of undergraduate students with disabilities using archival data from the University of Maryland Accessibility and Disability Service (ADS) database. Specifically, we aim to examine whether time of registration with ADS and length of accommodation use predict student GPA and time to graduation. The following section details the participants, procedure, and data analysis for this study.

Study Characteristics

Study Setting

The students in this study attended a large, four-year, public university in the mid-Atlantic region of the United States. The university is categorized as having very high research activity and is considered a "more selective" university in terms of college admissions (The Carnegie Classification of Institutions of Higher Education, 2017). As of fall 2018, total undergraduate enrollment was 30,762 (University of Maryland Office of Institutional Research, Planning & Assessment, 2019). Approximately 47 percent of undergraduate students were female; 49 percent were White, 17.3 percent were Asian, 11.6 percent were Black/African-American, and 9.5 percent were Hispanic.

Participants

Participants included students who utilized ADS accommodations between June 2015 and August 2018. June 2015 was selected as the start date because this is when the ADS office began using the electronic client management software, allowing for accurate tracking of accommodation use. August 2018 was selected as the end date to ensure that participants would

have been registered with ADS for at least three semesters at the time of data analysis in Fall 2019. The initial dataset included 3298 students. Participants were then limited to those who entered the university as degree-seeking undergraduate students. Graduate students, visiting students (e.g., study abroad), and those who entered as post-baccalaureate students were removed in order to focus specifically on the characteristics of degree-seeking undergraduate students. Transfer students were removed because we did not have access to information regarding transfer students' original college enrollment date or their use of disability services at their prior institution. Upon review of the initial data, students who entered UMD prior to August 2011 were also removed; this decision was made because many students in this category left the university and returned at a later point in time. Since we would not be able to obtain an accurate time to graduation for students with long gaps in enrollment, we eliminated these students from the sample.

The resulting sample included 1,980 undergraduate students who utilized ADS services between June 2015 and August 2018. Fifty-one percent of participants (*N*= 1,010) were female. The sample was 67.8% (*N*= 1,329) Non-Hispanic White, 9.4% (*N*= 187) Hispanic/Latino, 8.7% (*N*= 173) Black/African American, 7.5% (*N*= 149) Asian, and 7.2% (*N*= 142) Other (including Bi-or Multi-Racial) or Not Reported. Mean participant age was 22.7 years (*SD*= 2.0), with a range from 18.7 to 36.3 years. Since transfer students were not included in the final sample, all participants entered the university as freshmen. At the time of analysis in fall 2019, 41.7 percent of participants (*N*= 826) had graduated, and 9.2 percent (*N*= 183) had left the university prior to graduating. The remaining participants were seniors (*N*= 348, 35.8%), juniors (*N*= 329, 33.9%), sophomores (*N*= 245, 25.2%), or freshmen (*N*= 49, 5.1%). Students had been enrolled at UMD for an average of 5.2 semesters (*SD*= 2.0) out of the 8 semesters included in the study.

Participants' primary disability types included: Psychological (*N*= 591, 29.9%); ADHD (*N*= 581, 29.3%); Learning Disability (*N*= 287, 14.5%); Other/Not reported (*N*= 173, 8.7%); Medical (*N*= 168, 8.5%); Neurological (*N*= 63, 3.2%); Physical (*N*= 50, 2.5%); Brain Injury (*N*= 31, 1.6%); Deaf or Hard of Hearing (*N*= 18, 0.9%); and Vision (*N*= 18, 0.9%). See the "primary disability" variable below for a description of the disability classifications. Participants' majors by advising college were: Agriculture and Natural Resources (N= 81, 4.1%); Architecture (N= 16, 0.8%); Arts and Humanities (N= 247, 12.5%); Business (N= 192; 9.7%). Behavioral and Social Sciences (N= 409, 20.7%); Computer, Mathematical, and Natural Sciences (N= 364, 18.4%); Education (N= 28, 1.4%); Engineering (N= 254, 12.8%); Extended Studies (N= 1, 0.1%); Information Studies (N= 47, 2.4%); Journalism (N= 39, 2.0%); Letters and Sciences (N= 129, 6.5%); Public Policy (N= 8, 0.4%); Public Health (N= 149, 7.5%); and Undergraduate Studies (N= 16, 0.8%).

Procedure

The data for this study involved secondary data obtained from the larger database of the ADS client management system. When students register for ADS services, an electronic client file is created to store information relating to their accommodation needs and their interactions with the ADS office. Stored information includes disability type, date of ADS registration, approved accommodations, and all points of contact with ADS (such as follow-up appointments, downloading of accommodation letters, or use of the ADS testing center). The student's file also contains demographic information such as age, gender, race/ethnicity, date of university matriculation, college major, and cumulative GPA.

Given its nature as a secondary dataset, this study involved no direct participant interaction. The University of Maryland Institutional Review Board (IRB) approved the study as

exempt from full IRB approval due to the lack of interaction with human participants.. All necessary ADS data were exported from the ADS client management system to Microsoft Excel and STATA. Personally identifying information, such as name and university ID number, was removed and each participant was given a randomly-generated participant ID number for identification purposes. The primary investigator also obtained additional de-identified information on student graduation dates and semester GPA from the Office of the Registrar. Staff at the Registrar's office combined the datasets based on the random student ID number and returned the full de-identified dataset to the primary investigator. The data are stored on the primary investigator's password-protected computer, and no others have access to the dataset. All statistical analyses were completed in STATA and Microsoft Excel.

Study Variables

Demographic variables. Participant gender (coded as 1=female, 2=male), race/ethnicity (1= Asian, 2= Black/African-American, 3= Hispanic/Latinx, 4= Other/ Not Reported, 5= Non-Hispanic White), and class year (1= freshman, 2= sophomore, 3= junior, 4= senior) were coded categorically. While the author recognizes important differences between race and ethnicity, these variables were collapsed in order to simplify comparisons across groups and to be consistent with the federal reporting categories used by the university. Students who were reported as having more than one racial/ethnic identity were coded in the Other category.

Academic variables. Academic variables included date of matriculation at UMD; academic disciplinary action (i.e., academic probation or dismissal); cumulative GPA as of fall 2019; and semester GPAs at the end of each semester for four academic years (fall 2015 through spring 2019). Academic disciplinary action was coded categorically (0= no academic action, 1= academically dismissed, 2= academic probation). The dataset also included graduation dates for

students who had graduated before the start of the fall 2019 semester. Graduation status was coded dichotomously (1= graduated, 0= not graduated). Graduation dates were also used to create the time to graduation variable, which will be described below.

Time to graduation. Time to graduation was calculated for all students who had graduated before the start of the fall 2019 semester. A student's date of matriculation (month and year) was subtracted from their graduation date (month and year) in order to obtain their time to graduation in months. Months was selected as the unit of measurement instead of years because it is more easily interpretable as a regression coefficient, avoiding the interpretation of a fraction of years. We removed 13 students from the sample who entered the university prior to August 2011 in order to limit the number of students with potentially long gaps in their enrollment (This did not significantly alter the outcome variables.) It is recognized that some students still were not continuously enrolled at the university during this time period. Nonetheless, the time to graduation variable provides an indicator of the total amount of time it took a student to earn his or her degree from initial enrollment through graduation.

Disability-related variables. A number of disability-related variables were obtained for this study and will be described below.

***Primary disability*.** A student's primary disability is coded by ADS counselors at the time of ADS registration. Although many students have more than one disability diagnosis, counselors/staff at ADS determine the primary disability based on a student's disability documentation and the student's narrative regarding the academic impact of specific disability symptoms. Primary disability categories include: ADHD; Brain Injury; Deaf/Hard of Hearing; Learning Disability (LD; any type of Specific Learning Disability); Medical Disability (any type of chronic medical condition); Neurological Disability (neurological conditions such as Autism

Spectrum Disorders, Epilepsy, and Multiple Sclerosis); Physical Disability (chronic and temporary mobility impairments); Psychological Disability (psychological/ psychiatric disorders including Anxiety, Depression, Bipolar Disorder, Schizophrenia, and Specific Phobias); Vision Disability; or Other/Not Reported.

Delay to registration. Students' date of ADS registration was used to calculate the length of time (in months) that students had been registered with ADS by the conclusion of the study. Date of ADS registration was then compared to date of university matriculation to determine the number of semesters each student delayed before registering for accommodations. A semester was considered six months, since most students do not take classes over the summer or winter terms. If students registered with ADS before the start of their first semester at UMD, they were coded as 0; if students registered during their first semester (within six months after matriculating at UMD), they were coded as 1; and so on. Students (n= 49) who had delayed more than 12 semesters (six years) before registering for accommodations were eliminated from the analysis because of the likelihood that many of these students left the university and returned after an unknown period of absence. The resulting variable, called delay to registration, represents the number of semesters between students matriculating at UMD and registering with ADS. This semester-based variable is similar to—but more sensitive than—the variable used by Hudson (2018), which classified students based on year of registration.

Approved accommodations. Prior studies have classified disability accommodations and services in different ways. Mull et al.'s (2001) meta-analysis grouped services into program accommodations (e.g., course substitutions or priority registration), support services (e.g., tutors or counselors), and instructional adjustments (e.g., extended time on tests or note takers). Similarly, Schreuer and Sachs (2014) described academic accommodations (e.g., extended time

on tests or note takers), physical accommodations (e.g., accessible desks or handicapped parking), human support (e.g., tutors and counselors), and organizational/institutional support (e.g., disability-related financial aid). At UMD, the ADS staff are mainly involved in arranging academic accommodations to students. Other support services are available through different offices, such as the Counseling Service or academic departments. Thus, the current work focused specifically on academic accommodations.

We first calculated a total accommodation variable by summing the number of individual accommodations approved for each student. Next, informed by the categories created by Mull and colleagues (2001), we analyzed students' accommodations based on four main categories: Testing accommodations, classroom accommodations, adaptive technology accommodations, and program accommodations. If a student received any accommodation(s) in a given category, the student was coded as a "1" for that accommodation type. Otherwise, the student was coded "0" to indicate he/she did not receive that type of accommodation.

Testing accommodations included extended time on tests, breaks during tests, use of calculator, use of computer, ability to write directly on test instead of on a scantron, private testing space, and the ability to only take one exam per day. Classroom accommodations included preferential seating, the ability to take breaks during class, use of note takers, interpreters, or audio recording of lectures, use of computers to take notes, or modification of course due dates or course attendance policies. Adaptive technology accommodations involved the use of note taking software, screen reading softwares, assistive listening devices, alternate format of course materials (e.g., audiobooks or enlarged print), or taking exams using adaptive technology software. Finally, program accommodations included priority registration, allowance of a reduced course load, or use of the campus Paratransit system. It should be noted that

students periodically work with ADS staff to add or remove accommodations throughout their time in college based on their current needs. However, our analyses only included accommodations that were approved at the time of data analysis in fall 2019. For example, if a student was originally approved to use a calculator on tests but later asked for this to be removed from his/her accommodation letter, then use of a calculator would not be counted as an accommodation for this student in our analyses.

Appointment counts. All students in our sample attended an initial registration appointment with ADS staff. At the registration appointment, the student and the ADS counselor discuss the students' needs and determine appropriate accommodations based on the student's disability symptoms. The counselor also explains the process for implementing the accommodations and provides the student with access to their accommodation letter in the online portal system. After the registration appointment, the student is able to utilize their accommodations for the remainder of their time at UMD by logging into the online portal each semester (described below). However, students can request follow-up appointments with ADS staff at any time if they have difficulty implementing their accommodations, need to change their accommodations, or have questions related to working with professors or accessing other support services on campus. Each time a student returns for an appointment, the meeting is logged as a point of contact in the ADS database. We used this information to create a total for each student indicating the number of appointments each student attended throughout the eight-semester study period.

Length of accommodation use. Length of accommodation use was analyzed using documentation captured in the ADS database when students download their accommodation letters each semester. Students are required to download their letter each semester in order to

share the letter with professors and begin using their academic accommodations. In order to use other accommodations (such as program accommodations), students must contact the ADS office to coordinate the service. Whenever a student downloads their accommodation letter or contacts ADS staff, it is logged as a point of contact in the ADS electronic database. We recognize that there is no guarantee that students actually utilized their accommodations in a given class or semester even after they downloaded the letter; however, students typically download their accommodation letter just prior to meeting with their professor(s) to discuss implementing their accommodations for the semester. Thus, the action of downloading the accommodation letter each semester was considered a reliable proxy variable to estimate students' use of accommodations over time. If a student downloads his/her letter multiple times during the same semester, the action was counted only once because there are various reasons a student might re-download the letter (e.g., if the student recently updated their accommodations or if they want to remind themselves of their approved accommodations).

The letter downloads were summed on a semester basis to compute the total number of semesters, between zero and eight, that the student has downloaded his/her letter during the four year (eight semester) study period. This total provided an estimate of students' use of their established accommodations over time. Since this information was only available after the implementation of the ADS electronic database (in June 2015), students who registered with ADS prior to this date were not included in analyses for the length of accommodation use variable.

Accommodation use over time. While length of accommodation use showed the total number of semesters that a student used accommodations, we also wanted to examine each student's pattern of accommodation use longitudinally. The purpose of this variable was to

conduct longitudinal within-subject analyses to show the potential impact of accommodation use on student GPA over time. To calculate accommodation use over time, we converted students' accommodation use into time series data. First, we tallied accommodation use starting with the semester that a student initially registered with ADS, which was coded as semester 1 (to indicate the first semester the student used accommodations). The next semester that the student used their accommodations was coded as semester 2, and so on. If a student had gaps in their accommodation use (for instance, if a student failed to download their accommodation letter or implement any accommodations for a given semester), that semester was coded as 0 to indicate no accommodation use. The resulting dataset showed participants' patterns of accommodation use over each of the eight semesters in the study period (fall 2015 through spring 2019).

Data Analysis

Research Question 1

Descriptive statistics were used to answer research question 1 (What are the specific accommodation use patterns and academic outcomes of ADS students based on primary disability type, race/ethnicity, and gender?). Accommodation use patterns included approved accommodations, follow-up appointments, the average delay to ADS registration, and the average length of accommodation use. Academic outcomes included cumulative GPA, academic disciplinary actions, graduation rates, and time to graduation. We examined potential differences in the main accommodation and academic variables of interest based on demographic and disability-related factors (including race/ethnicity, gender and primary disability type). One-way Analyses of Variance (ANOVAs) were utilized to compare means for the numeric outcome variables (cumulative GPA, time to graduation, delay to register, and length of accommodation use) based on race/ethnicity and disability type. Single-sample *t*-tests were conducted to compare

means based on gender. Notably, ANOVA comparisons were not interpretable for three disability types (Brain Injury, Deaf/Hard of Hearing, and Vision disabilities) due to low sample size in these sub-groups.

For all ANOVAs and *t*-tests, Levene's test of homogeneity of variance was used to determine appropriate post-hoc analyses. Levene's test showed unequal variances across all of the ANOVA tests and two of the t-tests: In these cases, the Games-Howell correction (for ANOVAs) and the Satterthwaite correction (for *t*-tests) were used to interpret the results. To compare students' approved accommodations (a categorical variable) based on disability type, a chi-square analysis was used.

Assumption Testing for Regressions

Prior to conducting the regression analyses, the assumptions for linear regression were tested. Using residual plots and the Shapiro-Wilk W test for normal data, the data was determined to be roughly normally distributed. The Breusch-Pagan / Cook-Wiesberg test for heteroskedastcity showed that the assumption of homogeneity of variance of residuals was met for cumulative GPA but was violated for time to graduation. Therefore, heteroskedastic linear regressions were conducted for the time to graduation analyses. Testing for multicollinearity using the variance inflation factor (VIF) indicated that our data did not show issues with multicollinearity. Scatterplots with locally weighted least squares (lowess) smoothers showed strong linear fit for three of the four regression relationships. Some nonlinearity was found for the relation between delay to register and time to graduation; further visual analysis using kernel density plots showed a positive skew for delay to register, with many students registering before or during their first semester of college. A negative skew was also found for cumulative GPA, with few students having GPAs below 2.0.

After ensuring the assumptions were adequately met, regressions were conducted for research questions 2, 3, and 4, which will be described below. The characteristics of the regression analyses are depicted in Table 1.

Research Question 2

Two multiple regression analyses were conducted to address research question 2 **(**Does delayed registration with ADS predict cumulative GPA (*question 2a*) and time to graduation (*question 2b*), controlling for disability type and demographic characteristics?). The independent variable in both regressions was delay to registration. Delay to registration was coded as a continuous variable (range from 0-12) based on the number of semesters (six month periods) that a student delayed registering with ADS after matriculating at UMD.

Prior to conducting the regressions, moderation analyses were conducted to test the interactions of race/ethnicity, gender, and primary disability. None of the interaction terms were significant at the $p < .05$ level. This suggests that the relationships of interest were consistent among participants regardless of race/ethnicity, gender, and disability type. Thus, the moderation analysis was not retained and these variables were utilized as controls in the subsequent regressions.

Research question 2a. For regression 2a, the dependent variable, cumulative GPA, was a continuous numeric variable. We controlled for gender, primary disability type, race/ethnicity, and class year, which were all coded categorically using dummy variables. The reference categories, chosen alphabetically, were female (for gender), ADHD (for primary disability), Asian (for race/ethnicity), and freshman (for class year). We controlled for class year because students who had been at the university for a longer period of time may have different GPAs

than students who had been at the university for a shorter time. This regression included all participants in the sample, with one missing data point (*n*= 1,979).

Research question 2b. For regression 2b, the dependent variable, months to graduation, was a numeric variable. It indicated the number of months between a student enrolling in the university and graduating (if applicable). We again controlled for primary disability type, gender, and race/ethnicity. However, it was not necessary to control for class year in this regression because students would only have graduated if they had advanced through senior year. For this analysis, we only included participants who had graduated by the completion of the study (*n*= 825).

Research Question 3

Two multiple regression analyses were conducted to examine research question 3 (Does length of accommodation use predict student GPA (*question 3a)* and time to graduation *(question 3b),* controlling for disability type and demographic characteristics?). The independent variable for both regressions was length of accommodation use. Length of accommodation use was coded as a continuous variable based on the total number of semesters a student downloaded his or her accommodation letter after registering with ADS. Both regression 3a and 3b only included participants who registered with ADS after June 1, 2015. This decision was made to allow for an accurate depiction of students' accommodation use in the electronic tracking system, which was introduced on that date.

Prior to conducting the regressions, moderation analyses were conducted to test the interactions of race/ethnicity, gender, and primary disability. As mentioned above, none of the interaction terms were significant at the $p < .05$ level. Thus, the moderation analysis was not retained and these variables were utilized as controls in the subsequent regressions.

Research question 3a. For regression 3a, cumulative GPA was the dependent variable. As with question 2a, we controlled for primary disability type, gender, race/ethnicity, and class year. This analysis included 1,610 participants who registered after June 1 2015.

Research question 3b. For regression 3b, time to graduation was the dependent variable. As with question 2b, we controlled for primary disability type, gender, and race/ethnicity, but not class year. Only participants who registered after June 1 2015 and who had graduated by the completion of the study were included in this regression (n= 517).

Research Question 4

Multilevel Modeling (MLM) was utilized to answer research question 4 (Does accommodation use over time predict within-subject changes in GPA?). The MLM approach was chosen because of its computational efficiency with large time series datasets (Chou, Bentler, & Pentz, 1998). We tested both a linear and logarithmic model and found that both showed consistent results. Based on these models, we selected the linear model for its parsimony and ease of interpretation. This approach is similar to that used by DuPaul et al. (2017) in their analysis of disability support service use and academic outcomes over time.

Prior to running the regression, we investigated whether to utilize fixed or random effects using the Hausman test, which assesses whether the unique errors are correlated with the predictors. The results of the Hausman test indicated that the errors were significantly correlated with the predictors in our model ($p < .001$). Therefore, we utilized fixed effects for the MLM regression. A benefit of fixed effects for our data is that all within-subject characteristics that remain constant throughout the study, such as race/ethnicity, cultural, linguistic, and socioeconomic background, SAT scores, and high school GPA, are automatically taken into

account in the model. However, we also tested the MLM regression with random effects, and the results were consistent with the fixed effects findings.

Participant ID was used as the grouping variable for the MLM regression. For each semester (fall 2015 through spring 2019) that a student was enrolled, the student's semester GPA was matched with their accommodation use for that semester (if applicable). Accommodation use was coded by semester for each student. The first semester that the student used accommodations was coded as 1, the second semester was coded as 2, etc. If a student did not use their accommodations in a given semester, this was coded as 0 to indicate no accommodation use. Whenever the student began using their accommodations again, the coding scheme continued with the next number to indicate the true number of semesters the student had used accommodations. We coded accommodation use as a time-based count variable, as opposed to a dichotomous variable, in order to show the potential cumulative benefits of increased accommodation use over time. An example of the time series data coding is shown in Table 2. We did not center the data because we were only concerned with within-subject factors for this analysis and did not include any group level or cross-level terms.

For the MLM regression, accommodation use over time (the number of semesters the student had used accommodations at that point in time) was the independent variable. Semester GPA (the student's GPA during that particular semester) was the dependent variable. Because we needed to be able to observe changes in GPA over time (and at least three data points are necessary to create a trend line), only students who used accommodations for at least three semesters were included in this analysis (n= 1108).

CHAPTER 4: RESULTS

Research Question 1

Descriptive and exploratory analyses were conducted in order to answer research question 1 (What are the specific accommodation use patterns and academic outcomes of ADS students based on primary disability type, race/ethnicity, and gender?). *T*-tests and one-way analyses of variance (ANOVA) were used to determine whether student outcomes varied significantly based on gender, primary disability, and race/ethnicity. These variables were tested as potential control variables for the regression analyses.

Academic outcomes. Academic outcomes of interest included cumulative GPA, GPA by semester of accommodation use, academic probation/dismissals, and graduation statistics, which will be described below. Table 3 depicts participant academic outcomes based on the demographic characteristics of gender, race/ethnicity, and primary disability. Post-hoc pairwise comparisons examining differences in academic outcomes based on primary disability and race/ethnicity can be found in Tables 4 and 5, respectively.

***Cumulative GPA*.** On average, students' cumulative undergraduate GPA was 3.10 (SD= 0.60; range= 0.18 - 4.0). Females (M= 3.21, SD= .56) tended to have higher GPAs than males (M= 2.98, SD= .61; t (1977) = 8.98, p< .001). Cumulative GPA also varied significantly based on race/ethnicity (F(4, 1974)= 38.08, p< .001) and primary disability (F(9, 1969)= 8.27, p< .001). White participants tended to have higher GPAs, and Black/African-American students tended to have lower GPAs, than students of other races/ethnicities. Students with LD, medical, or physical disabilities had on average

higher GPAs than students with ADHD or psychological disabilities; and students with medical disabilities had on average higher GPAs than those with neurological disabilities.

GPA by Semester of Accommodation Use. Using the panel data, we also calculated averages for participants' GPAs broken down by semester of accommodation use. As shown in Table 6, the average cumulative GPA during the first semester that a student used accommodations was 3.06; during the second semester, it was 3.13; during the third semester, 3.15; during the fourth semester, 3.20. Average GPAs then remained higher during the fifth (*M*= 3.23), sixth (*M*= 3.28), seventh (*M*= 3.21), and eighth (*M*= 3.21) semesters. The increases in semester GPA were similar across semesters, increasing from a mean of 2.89 in semester 1 to a mean of 3.26 in semester 8 of accommodation use. Interestingly, for the overall sample, the average change in GPA from a student's first to last semester during the study period was close to zero (.009). This suggests that students who used accommodations for longer amounts of time tended to see increases in GPA across semesters that were not seen for other students.

Academic probation/dismissal. Overall, 46 students (2.3%) had been academically dismissed by the conclusion of the study, and 126 (6.4%) had been put on academic probation at some point in their university careers. Not surprisingly, the average cumulative GPAs among students who had been dismissed (*M*= 1.59, *SD*= .56) and those who had been on academic probation (*M*= 2.20, *SD*= .57) were substantially lower than that of the overall sample.

Additionally, we calculated the number of students who left the university for any reason without graduating by the end of the study period. This was determined based on whether students had any semester GPAs over the last year of the study (fall 2018

through summer 2019). Of the students who had not graduated as of fall 2019, 183 students (9.3%) had not completed a class at UMD within the past year. This includes students who were academically dismissed as well as those who left the university for various other reasons (e.g., medical or mental health reasons, family or financial circumstances, or transferring to another university). The average cumulative GPA among students who left the university prior to graduating was 2.38 (*SD*= .81).

Graduation statistics. Graduation statistics included graduation rates and time to graduation. Graduation rates were calculated using a cohort model based on the year that participants entered the university. Based on this model, the four year graduation rate for the 320 students who entered in fall 2015 was 56.3 percent; the five year graduation rate for the 298 students who entered in fall 2014 was 72.8 percent; and the six year graduation rate for the 202 students who entered in fall 2013 was 82.7 percent. These percentages were notably lower than those published by UMD for the general population of undergraduate students, particularly for four and five year graduation rates. Among all undergraduate students who entered in fall 2013, the four-year graduation rate was 69.5%; the five-year graduation rate was 85.4%; and the six-year graduation rate was 87.1% (University of Maryland Office of Institutional Research, Planning, & Assessment, 2019).

Among participants who had graduated by fall 2019, the mean time to graduation was 44.7 months (*SD*= 9.02), or 3.7 years, with a range of 12 to 90 months. Females tended to graduate in fewer months than males (t (823)= -3.13, p< .001). Time to graduation varied significantly based on race/ethnicity (F(4, 820)= 4.41, p< .01) and on primary disability. Specifically, White students tended to graduate in fewer months than

Black/African-American students. Students with physical disabilities tended to graduate in fewer months than students with ADHD or psychological disabilities. While significance comparisons could not be made due to small sample size, students with vision disabilities and brain injuries also had shorter time to graduation than most other students.

Disability service use outcomes. Disability service use variables included students' approved accommodations, appointment counts, delay between matriculating at UMD and registering for disability services, and length of accommodation use. Table 7 depicts participant accommodation use outcomes based on the demographic characteristics of gender, race/ethnicity, and primary disability. Post-hoc pairwise comparisons examining differences in accommodation use outcomes based on race/ethnicity and primary disability can be found in Tables 4 and 5, respectively.

Approved accommodations. As described in the Methods section, we classified accommodations into four over-arching categories: testing accommodations, classroom accommodations, adaptive technology accommodations, and program accommodations. It should be noted that most students were approved for multiple accommodations across several categories: On average, each student received a total of 3.45 different accommodations (SD= 2.44, range = 0 -17). Overall, 1674 students (84.6%) were approved for at least one testing accommodation, 1361 (68.7%) were approved for at least one classroom accommodation, 289 (14.6%) were approved for at least one adaptive technology accommodation, and 715 (36.1%) were approved for at least one program accommodation. Table 8 shows the frequencies of each specific accommodation under the four main accommodation categories. The most commonly approved

accommodations among our sample included extended time on tests (n= 1612), peer note takers (n= 697), priority registration (n= 657), and audio recording of lectures (n= 493). Table 9 depicts the percentage of students with each accommodation types based on primary disability.

Chi-square tests of independence revealed that approval for test accommodations (x^2 (9, N= 1980)= 225.10, p< .001); classroom accommodations (x^2 (9, N= 1980)= 81.29.10, p< .001); adaptive technology accommodations (x^2 (9, N= 1980)= 257.95, p< .001); and program accommodations (x^2 (9, N= 1980)= 90.86, p< .001) all varied based on primary disability type. Analysis of the adjusted residuals indicated when significantly more students with a given disability were approved for an accommodation type than would be expected. As shown in table 10, test accommodations were significantly more common among students with ADHD or LD, and less common among students with hearing, medical, psychological, or other/not reported disabilities. Classroom accommodations were significantly more common among participants with hearing or medical disabilities, and less common among participants with physical or other/not reported disabilities. Program accommodations were significantly more common among students with LD, neurological, medical, or vision disabilities, whereas they were less common among students with physical or psychological disabilities. Finally, adaptive technology accommodations were significantly more common among individuals with LD, hearing, or vision disabilities, and less common among those with medical or psychological disabilities. Since only the functional limitations related to a student's disability are considered when determining appropriate accommodations, other demographic variables were examined for approved accommodations.

Exploratory multiple regression analyses were conducted to examine whether approval for each of the accommodation types was associated with improved academic outcomes. Approval for test accommodations (F (1, 1977)= .13, p< .001), adaptive technology accommodations (F (1, 1977)= .08, p< .05), and program accommodations (F (1, 1977)= .06, p< .001) positively predicted cumulative GPA. Classroom accommodations, on the other hand, negatively predicted GPA (F (1, 1977)= -.10, p< .001). Adaptive technology accommodations was the only accommodation type that predicted decreased time to graduation (F (1, 823)= -2.18, p< .05). Test accommodations was the only accommodation type that predicted increased likelihood of graduating (F (1, 1978)= .08, p< .01).

Appointment counts. The majority of students (n= 1408, 71.1%) did not return for any follow-up appointments with ADS staff during the eight-semester study period beyond their initial registration appointment. Nearly 18 percent of students (n= 354) attended one follow-up appointment, six percent (n= 126) attended two appointments, two percent (n= 41) attended three appointments, and one percent (n= 23) attended four appointments. Only a small number of students (n= 28, 1.4%) attended more than four follow-up appointments, though the range reached as high as 16. It should be noted that these appointment counts did not include informal points of contact such as e-mails, phone calls, or drop-in conversations that students may have had with ADS staff.

***Delay to registration*.** On average, participants delayed 2.38 semesters (SD= 2.46, range = 0-12) between matriculating at UMD and registering with the disability service. The majority of participants (n= 1218, or 61.5%) registered by the end of their first year (second semester) on campus. Females (M= 2.49 semesters) tended to delay significantly

longer than males (*M*= 2.26 semesters) before registering for services (*t* (1978)= 2.05, *p* < .05). Delay to registration also varied significantly based on race/ethnicity (*F*(4, 1975)= 29.48, *p*< .001), and primary disability (*F*(9, 1970)= 42.57, *p*< .001). Specifically, Asian participants and Black/African-American participants tended to delay significantly longer than White participants or participants from the other race/multiple race category. Hispanic/Latinx participants also tended to delay significantly longer compared to White students. With regard to disability type, students with LD, ADHD, medical, and neurological disabilities registered significantly earlier on average than students with physical, psychological, and other disability types. Students with LD also registered significantly earlier than students with ADHD and medical disabilities. While the pairwise comparisons for the brain injury, hearing, and vision categories could not be interpreted due to small sample size, it is worth noting that students with hearing or vision disabilities had the shortest average delay in time to registration.

***Length of accommodation use*.** Students used ADS accommodations for an average of 3.23 semesters (*SD*= 1.99; range= 1-8) throughout the eight semester study period. Notably, 25.8 percent (*N*= 510) of participants only utilized their accommodations during a single semester. Length of accommodation use varied based on primary disability (*F*(9, 1970)= 39.65, *p*< .001), but not based on gender or race/ethnicity. Participants with ADHD, LD, medical, and neurological disabilities tended to use accommodations for significantly longer than participants with physical, psychological, and other disability types. Participants with LD, medical, and neurological disabilities also used accommodations for significantly longer than students with ADHD on average.

Based on the results of the *t*-tests and ANOVAs described above, variations were found in each of the dependent variables based on gender, race/ethnicity, and/or primary disability. Therefore, these variables were controlled for in the subsequent regressions, which will be described next. Class year was also used as a control variable for regressions 2a and 3a in order to account for the amount of time students had spent at UMD. Class year was not relevant for regressions 2b and 3b because only students who had graduated were included in these analyses.

Research Question 2

Two multiple regression analyses were conducted to address research question 2 (Does delayed registration with ADS predict cumulative GPA and time to graduation, controlling for demographic and disability-related factors?). Delayed registration, or the number of semesters a student delayed between matriculating at the university and registering with ADS, was the independent variable in both regressions for research question 2.

Research question 2a. In the first regression (2a), cumulative GPA was the dependent variable. Before the control variables were included in the analysis, delayed registration negatively predicted cumulative GPA (F (1, 1977) = -.06, p< .001) with an adjusted R^2 value of .05 (Table 11). Next, gender, race/ethnicity, class year, and primary disability were entered into the regression as controls. Delayed registration continued to negatively predict cumulative GPA (F (19, 1958)= -.08, p< .001) with an adjusted R^2 value of .31. This suggests that students who delay registration tend to have lower GPAs compared to students who register earlier in their university careers. Gender,

race/ethnicity, class year, and primary disability each emerged as significant predictors in the model, as shown in Table 12.

Research question 2b. In the second regression (2b), time to graduation (in months) was the dependent variable. Only students who had graduated were included in this analysis. Before the control variables were included in the analysis, delayed registration positively predicted time to graduation (F (1, 823) = 1.43, p< .001) with an adjusted R^2 value of .18 (Table 11). This result remained significant after controlling for gender, race/ethnicity, and primary disability (F (15, 809)= 1.53, p< .001), with an adjusted R^2 value of .21. Thus, students who delay registering tend to take longer to graduate compared to students who register earlier. Gender and primary disability type contributed significantly to the model, while race/ethnicity did not (see Table 12).

Research Question 3

To address research question 3 (Does length of accommodation use predict student GPA and time to graduation, controlling for demographic and disability-related factors?), two additional multiple regression analyses were conducted. As mentioned above, only students who registered with ADS after June 8, 2015 were included in these analyses. Length of accommodation use (in semesters) was the independent variable for both regressions for research question 3.

Research question 3a. In regression 3a, cumulative GPA was the dependent variable. Before the control variables were included in the analysis, length of accommodation use positively predicted cumulative GPA (F (1, 1610)= .06, p< .001), with an adjusted R^2 value of .04 (Table 11). Gender, race/ethnicity, class year, and primary disability were then entered into the regression as controls. Length of

accommodation use continued to positively predict cumulative GPA (F (19, 1589)= .04, p< .001) with an adjusted R^2 value of .24. This suggests that students who implement their accommodations for more semesters have, on average, higher GPAs than students who implement for fewer semesters. Gender, race/ethnicity, class year, and primary disability type were all significant predictors in the model, which is shown in Table 13.

Research question 3b. In regression 3b, time to graduation (in months) was the dependent variable. Only students who had graduated and who registered with ADS after June 2015 were included in this analysis. Before the control variables were included in the analysis, length of accommodation use negatively predicted time to graduation (F (1, 515)= -.45, p< .001) with an adjusted R^2 value of .01 (Table 11). The result remained significant after controlling for gender, race/ethnicity, and primary disability (F (14, 502)= -.43, p< .05), with an adjusted R^2 value of .07. Thus, students who implement their accommodations for more semesters graduate in fewer months, on average, than student who implement for fewer semesters. Gender, race/ethnicity, and primary disability significantly contributed to the model (Table 13).

Research Question 4

An MLM regression with fixed effects was used to answer research question 4 (Does accommodation use over time predict within-subject changes in semester GPA?). By using fixed effects, this analysis accounts for all stable individual characteristics, effectively comparing what a given student's GPA would have been without accommodation use to their actual GPA with accommodation use. In the first regression, accommodation use over time (by semester) was the independent variable, and

cumulative GPA each semester was the dependent variable. Participant ID number was the grouping variable.

For the MLM regression, accommodation use over time (by semester) was the independent variable, and semester GPA was the dependent variable. Participant ID number was the grouping variable. Results indicated that accommodation use over time positively predicted changes in semester GPA across semesters. The overall model was significant ($F(1, 5256)= 3.96$, $p < .001$). Specifically, the number of semesters a student had used accommodations at a given point in time had a significant positive effect on the student's GPA that semester ($\gamma = .05$, $p < .001$). This suggests that each semester that a student used accommodations was related to a small but significant increase in the student's cumulative GPA in a given semester. The MLM regression results are shown in Table 14.

CHAPTER 5: DISCUSSION

Research Summary

The current work investigated disability support service use and academic outcomes among undergraduate students with disabilities. Secondary archival data was obtained through the office of the Registrar and the electronic client database of the Accessibility and Disability Service (ADS) at a large, public, four-year university. Participants included 1980 degree-seeking undergraduate students who entered the university as first year students and who registered with ADS between June 2015 and August 2018. We examined whether time of ADS registration and length of accommodation use predicted two measures of academic outcomes (cumulative GPA and time to graduation). The relation between accommodation use and GPA was investigated both between- and within-subjects to show longitudinal changes across each of the eight semesters of the study period (fall 2015 through spring 2019). We also explored the accommodation use patterns of students across disability types and provided descriptive statistics for the variables of interest based on demographic and disability-related factors.

Descriptive analyses revealed the academic and disability service use characteristics of the study sample. Students' average cumulative GPA was 3.10, and a small percentage of students had been put on academic probation (6.4%) or had been academically dismissed (2.3%) during their university careers. Students were enrolled for an average of 5.2 of the eight semesters that were analyzed. Using a cohort analysis based upon year of matriculation, our findings showed a four year graduation rate of 56.3 percent, a five year graduation rate of 72.8 percent, and a six year graduation rate of 82.7 percent. Average time to graduation was 44.7 months, or 3.7 years, which is consistent

with four academic calendar years. Approximately 9 percent of participants had left the university by the end of the study period without graduating.

In examining accommodation use, we found that students were approved for an average of 3.45 different accommodations each. Of the four main accommodation categories, students more commonly received testing accommodations (*N*= 1,674 students) and classroom accommodations (*N*= 1,361) compared to program accommodations (*N*= 715) and adaptive technology accommodations (*N*= 289). Exploratory multiple regressions showed that approval for three of the four accommodation types (testing, program, and adaptive technology) positively predicted student cumulative GPA. On average, students delayed 2.38 semesters before registering with ADS and utilized their ADS accommodations for 3.23 semesters after registering. Most students (71.1%) did not return to ADS for follow-up appointments beyond their initial registration appointment. In analyzing pairwise comparisons, we found significant variation in both academic outcomes and disability service use based on student gender, race/ethnicity, and disability type. Therefore, we justified using these variables as controls in the subsequent regression analyses.

Overall, the quantitative results provided support for our hypotheses. For research question 2, we found that delayed registration with ADS negatively predicted cumulative GPA (F (19, 1958)= -.08, p< .001) and positively predicted time to graduation (F (15, 809)= 1.52, p< .001), even while controlling for the control variables listed above. Thus, students who registered early, particularly within their first year of university, tended to have better academic outcomes than those who registered later. For research question 3, length of accommodation use positively predicted cumulative GPA (F (19, 1589)= .04,

$p < .001$) and negatively predicted time to graduation (F (14, 502)= -.43, $p < .05$), while accounting for the control variables. Thus, students who implemented their accommodations for a longer period of time after registering were more likely to have better academic outcomes than other students. Finally, in research question 4, we found that accommodation use positively predicted within-subject changes in student semester GPAs ($\gamma = .05$, $p < .001$) across time. This means that every semester of accommodation use was associated with a small but significant increase in GPA each semester, even while accounting for all stable individual characteristics. Each of these findings will be discussed in more detail below.

Discussion

Research Question 1

Research question 1 investigated the academic outcomes and accommodation use patterns of our study participants. This research question was exploratory in nature, intended to describe the characteristics of the sample and investigate potential control variables for the regression analyses. Our discussion focuses on differences across academic and accommodation use outcomes based on primary disability type, race/ethnicity, and gender.

Academic Outcomes. The main academic outcome variables in our study included cumulative GPA and graduation statistics.

***Cumulative GPA*.** Students had an average cumulative GPA of 3.10. This finding was similar to the average GPA of 3.14 reported by Adams and Proctor (2010) but higher than that of most other previous samples (e.g., 2.96 in Abreu et al., 2016; 2.78 in Richman, 2014; 2.36 in DuPaul et al., 2017). This could be partially attributed to the

selectivity of the current university in accepting students who are prepared to be academically successful in college. Unfortunately, we did not have access to a comparison sample of students without disabilities at the same institution, though it seems that students in our sample were overall finding academic success at UMD. Importantly, cumulative GPA did vary based on all of our study control variables. Specifically, females tended to have higher GPAs than males. Students with ADHD or psychological disabilities had, on average, lower GPAs than students with LD, medical disabilities, or physical disabilities. Finally, White students tended to have higher cumulative GPAs than racial/ethnic minority students, and Black/African-American students tended to have lower GPAs than students of other racial/ethnic backgrounds.

Prior work has documented that students with specific disabilities tend to struggle academically in college: For example, Mamiseishvili & Koch (2017) found that students in their sample with LD or medical conditions were more likely to persist in college compared to students with ADHD, emotional/psychological conditions, or sensory conditions. Few studies have reported GPA among undergraduate students with disabilities broken down by demographic characteristics, though our findings are consistent with studies on undergraduate populations as a whole. For example, Koch et al. (2018) found that "being male, low-income, first-generation, a student of color, living with parents or off campus, and enrolling part time" were all factors that decreased the likelihood of college success (p. 363). Thus, it appears that demographic risk factors are similar for students with and without disabilities in college.

Graduation statistics. Graduation statistics were calculated for participants who matriculated at the university prior to the fall 2015 semester. In breaking up students by

cohort, we found a four year graduation rate of 56.3 percent (fall 2015 cohort), a five year graduation rate of 72.8 percent (fall 2014 cohort), and a six year graduation rate of 82.7 percent (fall 2013 cohort). This six year graduation rate was higher than that reported in some previous studies of students with disabilities (e.g., Hudson, 2018; Knight et al., 2018; Wessel et al., 2009), but it was consistent with the findings of Richman (2014). Importantly, each of these prior studies used cohorts of students who entered university 10 to 20 years earlier than the students in the current study. Secondly, as noted by Hudson, it is necessary to consider graduation rates in the context of an individual university, as schools differ significantly in their admission requirements, graduation requirements, and student populations. When comparing the findings within the university, students with disabilities in our sample tended to have lower four and five year graduation rates (56.3% and 72.8%, respectively) compared to the general undergraduate population as reported by the university (69.5% and 85.1%, respectively; University of Maryland Office of Institutional Research, Planning, & Assessment, October 2019). However, six year graduation rates were more equitable among our sample of students with disabilities (82.7%) compared the general undergraduate population (87.1%). These findings mirror those of Wessel et al. and Knight et al. (2018) in finding that students with disabilities are less likely to graduate in four or five years, but similarly likely to graduate in six years, compared to students without disabilities. Prior studies attributed this difference to some students with disabilities taking fewer credits per semester, resulting in a longer time to graduation.

In our sample, participants who graduated had an average time to graduation of 3.7 years. This is a substantially shorter time to graduation than previous studies (e.g., 4.8

years in Hudson, 2018; 4.4 years in Knight et al., 2018; 4.6 years in Wessel et al., 2009) and suggests that most students in our study graduated in the expected four-academic-year timeline. Our analyses revealed that time to graduation varied significantly based on participant demographic characteristics. Females graduated an average of 3 months sooner than males, a significant difference that has been shown consistently in prior work on undergraduate students with and without disabilities (e.g., King, 2000; Pingry-O'Neill et al., 2010; Wessel et al., 2009). Time to graduation also varied based on race/ethnicity, with White students tending to graduate an average of 4 months sooner than Black/African American students. Researchers (e.g., Keels, 2013; Koch et al., 2018) have attributed this racial difference in part to wealth disparity, parental education, and prior educational opportunities, variables which were not able to be measured in our data. Among our sample, students with physical disabilities, brain injuries, and vision disabilities tended to graduate several months sooner on average than students with ADHD or psychological disabilities. Previous studies (Dong & Lucas, 2016; Hudson, 2018; Newman et al., 2011) have also reported variation in graduation statistics based on disability type, particularly with regard to lower graduation rates among students with psychological/psychiatric disabilities. Therefore, while students in our sample were academically successful in college on the whole, it is necessary to consider demographic and disability-related differences when interpreting these findings.

Disability service use outcomes. The disability service use variables in this study included students' approved accommodations, appointment counts, delay between matriculating at UMD and registering for disability services, and length of accommodation use.

Approved accommodations. Students were approved for an average of 3.45 different accommodations, with testing accommodations and classroom accommodations being the most common accommodation types. While testing accommodations have been widely documented as the most common accommodation type offered in postsecondary institutions, it was still surprising that approximately 84 percent of students were approved for at least one testing accommodation. Further, nearly all of those students (82 percent of the total sample) were approved for extended time on tests. The efficacy of extended time accommodations have received mixed evidence in the existing literature, which has mainly focused on students with ADHD or LD (e.g., Lewandowski et al., 2013; Lindsay, 2017; Miller et al., 2015). However, our findings show that students with all disability types frequently use extended time on tests. Additional research is needed to confirm this finding, to validate the effectiveness of extended time, and to determine how often students actually use their extended time accommodations across their academic coursework. The electronic client database could be utilized to track students' use of extended time at disability service testing offices, which would provide more information about the usefulness of extended time for students with various disability types. Similarly, it was surprising that priority registration for classes was the third most common accommodation type, with one-third of students (n= 657) approved for this accommodation. Early class registration is often offered in order to allow students access to classes at specific times of day due to disability symptoms (for example, a student with ADHD may require classes early in the day to avoid inattention late in the day). The author is unaware of any studies that have examined the use or benefits of priority registration, yet clearly many students show a need for this accommodation. Examining

the impact of specific accommodation types on academic functioning is an important area for future research.

In analyzing students' approved accommodations, significant differences emerged based on disability type. Students with ADHD or LD were more likely to have testing accommodations than students with other disability types. Participants with medical or hearing disabilities were more likely to have classroom accommodations than other students. Program accommodations were the most common among participants with LD, neurological, medical, or vision disabilities. Finally, adaptive technology accommodations were the most common among participants with LD, hearing, or vision disabilities These findings are broadly consistent with the types of accommodations needed by students with particular disability types (e.g., individuals with ADHD or LD often have difficulty completing tests under typical timed conditions; individuals with LD, vision, or hearing disabilities often require alternate format of course materials using adaptive technology). Most existing studies on accommodation types have described the accommodations offered by universities but have not shown accommodations approved for students with specific types of disabilities (e.g., Barber, 2012; Mull et al., 2001; Newman & Madaus, 2015a). An exception is a study by Kim and Lee (2016), which portrayed test and classroom accommodations approved for students of various disability types. However, their study did not conduct pairwise comparisons of accommodation use by disability. Thus, our findings provide a clearer picture of all types of accommodations given to students with disabilities in the college setting.

Approval for three of the four accommodation types—test, adaptive technology, and program accommodations—positively predicted cumulative GPA. This finding is

consistent with several previous studies showing a positive relationship between specific accommodation use and student GPA (Kim & Lee, 2016; Mamiseishvili & Koch, 2011; Schreuer & Sachs, 2014). Interestingly, approval for classroom accommodations negatively predicted GPA among our sample. Kim and Lee (2016) also found that classroom accommodations did not significantly predict GPA after controlling for demographic and disability-related factors. It is possible that classroom accommodations are not as closely related to student GPAs as test or technology accommodations because they do not involve alteration or assistance on graded assignments. However, given that nearly 70% of participants were approved for at least one classroom accommodation, further exploration is warranted to determine the effectiveness of classroom accommodations compared to other accommodation types.

Appointment counts. With regard to appointment counts, we found that the majority of students (71%) did not return to ADS for formal follow-up appointments beyond their initial registration appointment. Eighteen percent of participants attended one follow-up appointment, while only 11 percent attended more than one follow-up appointment during the study period. Generally, the purpose of follow-up appointments is to add/change accommodations, address problems with implementing accommodations, or obtain assistance with accessing specific services or accommodations. Females and students with neurological disabilities, vision disabilities, and students who are Deaf/Hard of Hearing tended to attend more follow-up appointments on average than other students. The disability-related differences likely indicate the specific needs of students with these disability types, such as the need for students who are Deaf/Hard of Hearing to work with ADS staff to obtain interpreters or captioning services in their

classes. Students with other disability types may be able to adequately implement their accommodations without additional assistance from ADS staff.

One of the few studies to examine disability service appointment counts found a substantially higher percentage of students (67%) returned for at least two appointments with the disability service (Richman, 2014). However, the disability office in Richman's study offered a broader scope of services, including coaching, academic tutoring, and support groups, compared to the ADS office in the current study. Work by Abreu and colleagues (2016) also showed that students self-reported visiting the disability service office an average of 4.7 times per semester, and that the number of visits positively correlated with student GPA. At that university, students were required to return to the disability service office to establish their accommodations each semester, which is a more common practice at smaller colleges universities. Many students in our sample were likely able to use their academic accommodations successfully without needing to return for follow-up appointments. In addition, the appointment count did not include student contacts with ADS staff over email, phone, or via informal drop-in conversations. Thus, students in need of assistance likely contacted their ADS counselor via other means of communication in lieu of formally scheduled appointments. Additional survey or interview data would be required to confirm whether students were able to receive follow-up support from ADS staff when needed.

Delay to registration. Participants waited an average of 2.38 semesters (*SD*= 2.46) between matriculating at UMD and registering with the disability service. Since we calculated semesters as six-month intervals, this equates to waiting approximately 14 months before registering for disability accommodations. Nonetheless, nearly 62 percent

of participants registered within their first two semesters of college. The only known study to quantitatively examine timing of registration is the dissertation study completed by Hudson (2018), which revealed similar findings in this area. Among Hudson's sample, students delayed an average of 18 months before registering, and 58.2% of students disclosed their disability by the end of their first year of college. While Hudson did not find differences in registration time based on gender, in our sample females waited slightly but significantly longer than males (M= 2.49 semesters compared to 2.26 semesters) to register for accommodations. This difference was unexpected but may be partially explained by the higher prevalence of psychological conditions—which may develop during a student's college career—among females compared to males (Eaton et al., 2012).

In examining disability type, Hudson (2018) found that students with medical, physical, hearing, or vision disabilities were the most likely to register within their first year of college, followed by students with cognitive disabilities (such as LD or ADHD), students with multiple disabilities, and then students with psychological disabilities. Our findings were similar: Students with vision or hearing disabilities tended to register for accommodations the earliest, within the first semester of matriculating on average. Students with LD, ADHD, neurological disabilities, and medical disabilities generally registered by the end of their second semester. Students with conditions that are more likely to develop during college, such as brain injuries, physical disabilities, and psychological disabilities, tended to register the latest (an average of three or more semesters after matriculating). Obtaining a larger sample size of students with less

prevalent disabilities—namely hearing, vision, and brain injuries—would allow for stronger comparisons based on disability type.

Likewise, Hudson was not able to make comparisons based on race/ethnicity due to the small proportion of racial/ethnic minority individuals in her sample. Among our sample, White students tended to register for disability services significantly earlier than students of other races and ethnicities. Prior work has suggested that students who are White and students from higher income families are more likely than their peers to use disability accommodations in college (Cawthon et al., 2015; Koch et al., 2018). A possible explanation for this racial difference is the prevalence of postsecondary transition services among higher-income schools, which often have disproportionately White student populations. Research suggests that students who receive transition services in high school, such as participating in IEP meetings or meeting with a college advisor about disability-related needs, are more likely to register with the campus disability service within the first semester of college (Lightner et al., 2012).

Notably, in comparing our sample to the total student population at UMD, only approximately five percent of undergraduate students were registered with ADS each year. Studies show 11 percent of U.S. undergraduate students report having a disability (Raue & Lewis, 2011), with the true numbers estimated to be even higher given the number of students who choose not to disclose their disability in college. Thus, ADS services are under-utilized at UMD compared to colleges nationwide.

Length of accommodation use. On average, students in our sample used their accommodations (as measured by downloading their accommodation letter) for a total of 3.23 semesters (*SD*= 1.99; range= 1-8). This equates to approximately a year and a half

of accommodation use. Importantly, we calculated the total number of semesters a student used their accommodations, so these semesters were not necessarily continuous. For instance, if a student took a semester off from school or decided not to implement their accommodations for a given semester, they might still return to using their accommodations during a future semester. Similar to the findings described above, students with disabilities that are more commonly temporary conditions, such as physical disabilities and brain injuries, tended to use accommodations for the fewest number of semesters (*M*= 1.82 and 2.48, respectively). With the exception of students who are Deaf/Hard of Hearing (*M*= 2.72), students with disabilities that are typically chronic or lifelong generally used accommodations for more semesters than the sample average. This included students with ADHD (*M*= 3.69), LD (*M*= 4.04), Neurological Disabilities (*M*= 3.90), and Vision Disabilities (*M*= 4.28). Despite differences in timing of registration based on gender and race/ethnicity (described above), students did not differ based on gender or race/ethnicity in their length of accommodation use.

Importantly, no known prior work has calculated length of accommodation use in this way using the electronic database system to estimate accommodation use over time. Most prior studies have used disability service registration as a proxy for accommodation use (Hudson, 2018; Kim & Lee, 2016; Lombardi et al., 2012) or have tracked meetings with disability service and support service staff longitudinally (Abreu et al., 2016; DuPaul et al., 2017; Richman, 2014). Neither of these approaches measure student use of academic accommodations across time. Subsequently, there is no established baseline by which to compare our finding that students utilized accommodations for an average of 3.2 semesters. However, it is worth noting that one-fourth of participants (N= 510) only

implemented their accommodations for a single semester. This is consistent with Richman's (2014) finding that one-third of students in her sample never returned to set up/implement their accommodations after an initial intake meeting with disability service staff. While it is necessary for these findings to be replicated in future work, it is clear that a substantial number of students with disabilities do not continue to consistently use accommodations throughout college after registering with their campus disability service. Potential reasons for and implications of this finding are discussed in more detail in the discussion of Research Question 3 below.

Research Question 2

Research question 2 examined whether delayed registration with ADS predicted cumulative GPA and time to graduation, controlling for disability type and demographic characteristics. Consistent with our hypotheses, we found that delayed registration with ADS negatively predicted cumulative GPA and positively predicted time to graduation. These findings remained significant after controlling for gender, race/ethnicity, class year, and primary disability type. Therefore, students in our sample who delayed longer before registering for accommodations tended to have lower GPAs and take more time to graduate compared to students who registered earlier.

With regard to student GPA, our results are consistent with those of prior work in suggesting that use of disability services or accommodations is related to higher cumulative GPA (Abreu et al., 2016; DuPaul et al., 2017; Kim & Lee, 2016). More specifically, we found that each semester a student delayed before registering with ADS was associated with an average decrease of -.08 in cumulative GPA. Our analysis provides support for Lighter et al.'s (2012) finding that students who registered for

accommodations earlier in college typically performed better academically than those who delayed. Lightner and colleagues separated their participants into three groups based on time of registration: The early group registered within a month of starting college, the later freshman group registered during their first year, and the late group registered after their first year. After one semester of college, participants' GPAs were not significantly different across groups. However, by the middle of sophomore year (after three semesters of college), students who registered earlier showed significantly higher GPAs and number of credits earned compared to other students. While their sample size was small, the authors concluded that the positive change in GPA among the early registrants could be related to their use of supports and accommodations from the disability service. By controlling for disability type and available demographic characteristics, our analysis supports suggests that time of registration plays a small but significant role in predicting GPA above and beyond these factors.

Similarly, our findings mirrored those of several previous studies in showing a significant relation between early disability service registration and time to graduation. Research has suggested that the use of specific disability accommodations is associated with an increased likelihood of persisting in college (Mamisheishvili & Koch, 2011) and of graduating (Pingry et al., 2012). In examining the impact of time of registration, Hudson (2018) found that students who registered with the disability service after their first year of college had 3.5 times higher risk of not graduating compared to those who registered within their first year. Hudson also revealed that each year of delay in registration was associated with an average increase of approximately 5 months in time to graduation. Among our sample, students who delayed registration also tended to take

longer to graduate than students who registered earlier. Specifically, each semester (six months) of delay was associated with an increase of approximately 1.5 months in time to graduation. This means that each year of delay would be related to an increase of 3 months in time to graduation. While our effect was slightly smaller than that found by Hudson, an increase of 3 months in time to graduation would still require a student to register for an additional semester of college in order to graduate, making the time increase even more significant.

It is encouraging that the majority of participants in our study (62 percent) registered with the disability service within their first year of college. The ADS office, and the university Counseling Center more broadly, have implemented outreach campaigns over the last several years aiming to increase awareness and decrease stigma surrounding the use of disability services or mental health treatment on campus. There have also been efforts on a broader level to improve high school transition services to support students with disabilities in the postsecondary setting (e.g., Koch et al., 2018). While efforts to build awareness and decrease stigma have likely improved disability disclosure rates at UMD, students in our sample still delayed an average of 2.38 semesters before registering. There are several reasons that might explain this length of delay.

Firstly, students who develop or are initially diagnosed with a disability while in college would become eligible for disability services after their diagnosis. Even students who are diagnosed during childhood are often reluctant utilize disability services in the postsecondary setting for a variety of reasons. For example, as shown by Newman et al.'s (2011) study, a large proportion of young adults with disabilities do not consider

themselves to have a disability upon entering college. This is particularly common among students with non-visible disabilities, such as learning disabilities or ADHD (Newman et al., 2011). Other individuals who do self-identify as having a disability may still hesitate to register with the disability service due to the stigma around disability symptoms and accommodation use, as well as the desire for independence (Cawthorn & Cole, 2010; Lightner et al., 2012; Martin, 2010). Among Lightner et al.'s (2012) sample, the majority of college students with LD waited to seek out disability support services until after they experienced an academic crisis. Finally, a lack of transitional support means that many college students do not understand the process of how to obtain disability supports in the college setting. Thus, many students with disabilities struggle to access, or are not willing to access, available disability supports in college. Given that our findings show a relation between early accommodation use and academic outcomes, efforts should be made to help students engage with disability services early on in college, if they desire to do so. Recommendations for such efforts are outlined in the Implications for Practice section below.

Research Question 3

Although research question 2 focused on the role of delay to registration, research question 3 examined whether length of accommodation use predicted student academic outcomes when controlling for demographic and disability-related factors. As hypothesized, we found that total length of accommodation use (in semesters) positively predicted cumulative GPA and negatively predicted time to graduation. Both analyses remained significant after controlling for gender, race/ethnicity, class year, and primary disability. Thus, among our sample, students who used accommodations for a longer

period of time throughout college tended to have higher GPAs and take less time to graduate compared to students who used accommodations for a fewer number of semesters.

The findings of research questions 2 and 3 are similar in showing a positive association between the use of ADS services and academic outcomes. Indeed, the two independent variables in our study—delay to registration and length of accommodation use—are certainly related, since delaying longer to register means there is less time remaining in a student's college career in which to use disability services. However, the distinct purpose of research question 3 was to investigate the potential impact of continued service use over time. If disability accommodations are in fact beneficial in helping students with disabilities fully access the college academic environment, then using accommodations for a longer period of time should be associated with higher academic success. It is known that many students who register for accommodations do not continue using them throughout college. As noted by Schreur and Sachs (2014), the single act of registering with the disability service is insufficient if students fail to consistently implement the accommodations across time.

To the author's knowledge, this question has not been examined in prior work. Several studies have suggested that higher levels of engagement with campus support services—as measured through meetings with the disability service and other support staff—are positively related to student GPA and graduation rates (Abreu et al., 2016; DuPaul et al., 2017; Richman, 2014). However, these works did not examine the use of academic accommodations, which are the most common service type offered to and utilized by postsecondary students with disabilities. Our findings build upon these prior

results in showing that students who use accommodations for more semesters tend to perform better academically and graduate earlier than students who use accommodations for fewer semesters. As with research question 2, the size of the effect was small, with each semester of accommodation use predicting an average increase of 0.04 in cumulative GPA and decrease of 0.5 months in time to graduation. However, if a student continued to implement their accommodations each semester throughout college, these effects could be compounded over time.

Additionally, we found that many students did not continue using their accommodations throughout college, with 25 percent of participants only utilizing accommodations for a single semester. One explanation for the dropoff of accommodation use over time is the presence of temporary disabilities or improved symptoms. The symptoms of certain disability types, including some psychological disorders (e.g., anxiety or depression), some medical or neurological conditions (e.g., a concussion or Lime's Disease), and some physical conditions (e.g., a broken arm) may subside over time; the symptoms of many disorders can also be remediated by treatment. In these situations, students may not require continued use of accommodations after their symptoms diminish. This reasoning is consistent with our finding that students with more temporary or later-developing disabilities (such as Brain Injuries or some physical disabilities) tended to use accommodations for the shortest amount of time.

Another potential explanation is that some students register for accommodations as a "safety net" upon entering college, often urged to do so by parents, but they do not intend to actually implement the accommodations. Lightner et al.'s (2012) qualitative work showed that students commonly report wanting to complete college without the use

of disability accommodations; self-reliance also emerged as a key over-arching theme in Stennis Moore's (2017) qualitative study of the experiences of college students with disabilities. Thus, the desire for independence can inhibit students from wanting to implement their accommodations even after registering with the disability service. Similarly, stigma surrounding the use of disability accommodations has been documented in prior studies (Denhart, 2008; Martin, 2010; May & Stone, 2010). If students are concerned that professors or peers will judge them for having a disability or using accommodations, they are less likely to continue implementing their accommodations throughout college.

Finally, research suggests that many students with disabilities struggle with the heightened level of independence required to implement postsecondary accommodations (Cawthorn & Cole, 2010; Lightner et al., 2012). Although ADS staff review procedures at the registration meeting and send email reminders each semester, some students fail to complete the process of sharing their accommodation letters with instructors each semester. These possible explanations are informed by previous studies and the author's work at the disability service office, but future work should qualitatively examine the reasons for students' decisions around accommodation use. Nonetheless, as the first known study to track accommodation use over time with the electronic client management system, our findings provide an initial estimate of students' patterns of accommodation use throughout college and the relation between accommodation use and positive academic outcomes.

Research Question 4

The findings of research questions 2 and 3 provide support for the positive association between disability accommodation use and college academic outcomes, while controlling for available demographic and disability-related factors. However, between-subject analyses (without experimental manipulation) are inherently limited in that they are unable to control for many possible confounds. Consistent with Tinto's (1975) framework, there are various individual and environmental factors that might increase the likelihood that students who register for services earlier or use them more consistently also tend to perform well academically. For instance, individual characteristics including self-awareness, perseverance, self-advocacy skills, and interpersonal skills likely contribute to both academic achievement and the ability to follow through with registering for and using disability support services. In a research report investigating students with disabilities (SWDs) who had successfully completed college, Barber (2012) found that "a common thread amongst the successful SWDs in this study was an ability to understand their disability and advocate for the accommodations they needed to successfully engage in their education" (p. 6). Additionally, due to the secondary nature of this dataset, we did not have access to many environmental variables that could influence the findings. Variables such as participant IQ, SAT scores or high school GPA, socioeconomic status, or family educational, cultural, and linguistic background are known to influence students' success in college. Therefore, while our findings are encouraging in showing a relation between use of disability services and academic outcomes, we acknowledge the many other factors that could be involved in predicting these relationships.

Given the limitations of research questions 2 and 3, the purpose of research question 4 was to analyze the impact of accommodation use longitudinally within-subjects. Using a within-subjects fixed-effects model meant that any individual factors that are stable over time (such as those mentioned above) were automatically taken into account. It also allowed us to make stronger inferences about the true relation between accommodation use and academic outcomes by tracking a given student's GPA across time. Although it is often used with nested data, the Multi-Level Model (MLM) approach is supported by the literature as a strong methodology for examining large time series datasets and has been used by similar studies in this area (Chou, Bentler, & Pentz, 1998; DuPaul et al., 2017).

Using the MLM approach, we found that each additional semester of accommodation use predicted a small but significant increase in a student's semester GPA at a given point in time. This means that students who used accommodations for a longer amount of time had higher GPAs across time than would be predicted without the use of accommodations. This finding provides stronger support to the findings of research question 3 in showing that length of accommodation use is related to improved GPA. Whereas the analysis in research question 3 compared cumulative GPAs across groups, the MLM analysis compared each student to his/herself across time. This model takes into account all fixed individual characteristics, such as IQ, high school GPA, childhood home environment, and many others, which could have been contributing to the significant findings of research questions 2 and 3. By examining changes in GPA within individuals, we found that the continued use of accommodations throughout college predicted a small but significant increase in GPA each semester compared to

what a given student would be expected to have without using accommodations. The predicted increase in semester GPA (.05 points per semester of accommodation use) was consistent with that found by DuPaul and colleagues (2017) in their examination of support service use and academic outcomes: Their results showed that meetings with tutoring or coaching staff were associated with an increase of 0.01 to 0.04 in semester GPA for students with ADHD or LD. However, DuPaul et al.'s study is the only known study to analyze service use and academic outcomes within-subjects. We extend these findings by examining academic accommodation use with a sample of students with all disability types. Though the predicted GPA increases per semester were small, students who used accommodations during each semester of college could be expected to have an incremental increase in GPA each semester that they use accommodations.

One potential explanation for the small effect found in our analysis is that, overall, students' GPAs remained fairly stable throughout college: The average cumulative GPAs among our sample were relatively consistent during participants' first and last semesters on campus. Given the competitive nature of the UMD admissions process and the high academic expectations, it is possible that students who were accepted into the university already had the requisite academic skills to succeed in college. Many students may develop strategies to compensate for their areas of weakness, such as studying further in advance or attending extra help sessions. Students with disabilities also often report "self-accommodating" by implementing tools they have found to be useful (for example, a student with a reading disability may choose to purchase audio versions of textbooks). If students already possess the knowledge and skills to complete college-level work, then it is logical that adding disability

accommodations may only provide a small benefit to already successful students. This is in line with our finding that students in our sample largely found academic success in college in terms of their GPAs and graduation rates.

Another factor that may have contributed to our findings was the inclusion criteria for the MLM analysis. Only participants who used accommodations for at least three semesters were included in the MLM regression in order to produce slopes and trend lines for each participant. This eliminated approximately one-third of the original sample and may have limited our effect. In comparing students' average GPAs, students who used accommodations for three or more semesters had higher GPAs overall (M= 3.18) compared to students who used accommodations for less than three semesters (M= 2.99). If we had been able to include all participants, it is possible that we would have seen a slightly larger increase in GPA over time.

While the size of the effect was small, the results remain significant in showing an increase in within-subject GPA with increased accommodation use over time. The importance of this finding lies in the novelty of our methodology: The author is unaware of any studies that have tracked accommodation use in relation to student academic outcomes over time. As described earlier, a limited number of studies thus far have utilized the existence of electronic client management systems to describe accommodation use cross-sectionally (e.g., Kim & Lee, 2016; Lombardi et al., 2012). Researchers who have examined academic outcomes for students with disabilities longitudinally (e.g., DuPaul et al., 2017; Hudson, 2018; Mamiseishvili & Koch, 2011; Troiano et al., 2010; Pingry O'Neill et al., 2012) have either not looked at academic accommodations or not considered continued accommodation use beyond the initial

registration with the disability service. By examining length of accommodation use based on students implementing their accommodations in the electronic system each semester, we provide a clearer picture of the true relationship between accommodation use and academic outcomes. Overall, the results from research question 4 provide strong evidence to encourage the early and consistent use of accommodations throughout college, as increased service use can provide further benefit to students across time.

Limitations

Despite the encouraging findings in favor of disability support services, there are several limitations to this study that warrant discussion. As mentioned earlier, academic outcome data must always be interpreted within the context of the specific university setting in which it was collected. Institution-level characteristics are one key component of Tinto's framework (1975) in determining students' postsecondary success. UMD is a large, research-intensive university with a moderately selective admissions process and strong campus-wide academic outcomes. Each of these characteristics likely contributed to our participants' academic outcomes being higher on average than those of most prior studies. Additionally, the unique policies and procedures of the ADS office influenced our findings compared to other work. For instance, students in our sample were not required to return to the ADS office to renew their accommodations each semester, as is required at many smaller colleges (e.g., Abreu et al., 2016); this likely explains the low percentage of students attending follow-up visits after registering for accommodations. Campus climate surrounding issues such as stigma also plays a role in students' willingness to implement accommodations. Therefore, the findings of our study portray the accommodation use patterns and academic outcomes of students who were registered

with the UMD disability service between 2015 and 2019. While our results should be used to inform future work in the area, they should be interpreted within this particular time and place and may not generalize to all other colleges nationwide and globally.

Another important limitation involves the lack of comparison group to students with disabilities who did *not* disclose their disability to the university or register for services. Our longitudinal results allowed us to track differences among students who registered early on in college compared to those who registered later. However, it is possible that students who never register may have different demographic characteristics or academic outcomes compared to students who do register for disability services. Unfortunately, universities are prohibited from inquiring about student disability status by laws such as the ADA and Section 504. Due to concerns regarding ethics and feasibility, researchers generally cannot identify college students with disabilities unless students choose to disclose their disability to the university. A notable exception was the NLTS-2 study (Newman et al., 2011), which monitored youth with disabilities for eight years after high school. This method allowed the researchers to track students' postsecondary outcomes, regardless of whether they registered for disability accommodations in college. Newman and colleagues (2011) reported that receipt of accommodations in college did not significantly vary based on race, gender, or family income, but did vary based on disability type (with students with visible disabilities such as hearing, visual, or physical impairments being more likely to receive accommodations in college than students with LD, ADHD, or speech/language impairments). Dong and Lucas (2017) also compared students who did and did not register for accommodations across two years of college and found academic differences based on disability type.

Future studies should utilize this longitudinal framework using survey data to obtain more information about the characteristics of students who do not disclose their disability to their university in college.

A final consideration is the extent to which causality can be inferred from our findings. As discussed in the preceding discussion, the results of research questions 2 and 3 are associative in nature; we found that students who registered earlier and used accommodations for a longer period of time tended to have better academic outcomes than other students in our sample. We controlled for available background characteristics, namely gender, race/ethnicity, class year, and disability type. However, many other individual and environmental factors could have contributed to these findings. With regard to research question 4, we showed that length of accommodation use predicted within-subject changes in GPA over time. By comparing changes within individuals (and therefore holding all fixed individual factors constant), this analysis provides much clearer evidence that accommodation use predicts academic success. Nonetheless, a multitude of factors predict students' success in college. It is possible that another factor, such as social support or increased motivation, explains the connection between disability service use and positive academic outcomes. We acknowledge that true causality cannot be determined without the use of experimental manipulation. To date, the only experimental studies on postsecondary accommodation use have involved very small samples of students with LD or ADHD and have lacked generalizability to actual accommodation use (e.g., Lewandowski et al., 2013; Lindsay, 2017; Miller et al., 2015). While our methodology, particularly in research question 4, provides strong support for our hypotheses, we caution against making causal conclusions of these findings.

Conclusion

Implications for Research

Both the results of our study and the limitations described above can inform future work in the area of postsecondary disability services. Thus far, existing findings have been mixed regarding the association between accommodation use and college success. Given the dearth of existing literature on the topic, more studies are needed to confirm the relationships we found between early and consistent accommodation use on academic outcomes. While our findings mirrored those of Hudson (2018) with regard to timing of registration, we were unable to locate any studies that had examined total length of accommodation use over time. Replication of our work at different types of institutions, such as liberal arts colleges, 2-year institutions, and colleges with varying student demographics and admissions criteria, would improve the generalizability of our findings to the larger population of students with disabilities across the country. Increased sample sizes of students with lower prevalence disabilities will also help bolster comparisons across groups.

Additionally, researchers should begin to take advantage of electronic client management systems to more accurately depict students' actual accommodation use over time. Future work should examine the potential role of using specific accommodations, such as extended time on tests or note takers, on students' academic outcomes throughout their college careers. Although these relationships have been shown cross-sectionally (e.g., Kim & Lee, 2016; Schreuer & Sachs, 2014; Pingry et al., 2012), it is important to compare longitudinal changes within-subjects to eliminate the impact of individual and environmental factors. The use of electronic management systems could also be used to

track students who take tests at the disability office testing center or use note taking services, which would provide another estimate of actual accommodation use. Finally, there should be an increased emphasis on qualitative or mixed-method work to provide context to the relation between service use and student outcomes. Studies such as that of Lightner et al. (2012) and Scheuer and Sachs (2014) can reveal valuable information about students' decisions about whether and when to use disability accommodations, barriers to accommodation use, and the perceived helpfulness of such services. Researchers should seek to obtain data regarding students' background characteristics and history of accommodation use prior to college to provide more context about decisions to disclose in college.

Implications for Practice

In addition to implications for future research, our work can inform recommendations for students with disabilities and disability services providers in both the high school and college settings. Much of the college retention literature emphasizes that early integration into the college academic and social environment is key to postsecondary success (Astin, 1993; Bozick, 2007; Tinto, 1993, 2006, & 2012; Pascarella & Terenzini, 2005). Our findings support this concept in showing a positive relationship between early use of disability services and academic outcomes. However, the small percentage of undergraduate students (5%) who registered with the disability service suggests under-utilization of these potentially beneficial supports. Prior work has identified evidence-based recommendations to promote students' awareness and knowledge of available postsecondary supports (e.g., Knight et al., 2018). In high school, this can include student involvement in IEP or 504 meetings to better understand their

disability-related needs, and transition programming to prepare students for accessing college-level services. Once in college, students would benefit from orientation programs specifically geared toward students with disabilities to ensure a smooth transition to the increased independence of accessing accommodations in college and to increase students' willingness to utilize accommodations. Disability services and university departments can also collaborate to conduct trainings to improve faculty awareness and reduce stigma surrounding disabilities and accommodation use. These efforts will likely improve the number of students who register for accommodations early on and continue using services throughout college.

Several recommendations specific to disability service offices warrant discussion. Given the small number of students (29%) in our sample who returned for follow-up appointments, disability offices should seek ways to ensure that students are willing and able to attend additional appointments if they require further support. While individual appointments can be difficult to schedule due to staffing and time considerations, disability offices could consider implementing group sessions to continue engaging students. Examples include disability-specific support groups or informational sessions at the beginning of each semester reminding students how to implement their accommodations. Students should be encouraged to integrate accommodation use with other available campus wide support services, such as tutoring, advising, and coaching. Engagement with these services and with disability staff have been shown to be beneficial for students with disabilities (DuPaul et al., 2017; Troiano et al, 2010). Disability staff should also ensure that they work with students to individualize their required accommodations. For example, we found that 81 percent of students were

approved for extended time on tests; it is important to consider the limitations of the student's disability when granting accommodations, rather than provide a set list of accommodations to large groups of students.

Finally, disability offices should make particular efforts to ensure that racially/ethnically diverse students and students from lower income or less advantaged backgrounds have the knowledge and ability to access disability services. Students in our sample were disproportionately White compared to the general undergraduate population of the university, as has been the case with prior studies (e.g., Hudson, 2018; Koch et al., 2018). This suggests that there may be a higher number of racial/ethnic minority students with disabilities who either choose not to disclose or are unaware of the disability services available to them in college. Coordination with academic advising services who meet with students each semester may improve student awareness of available supports. Disability service providers should ensure services are provided in a culturally responsive manner in order to decrease stigma and increase help-seeking among students from diverse backgrounds (Wang, Do, Frese, & Zheng, 2019). Lastly, disability service staff should be encouraged to disseminate information to students about community resources, such as low-cost evaluation services or community mental health supports. These efforts can aid in the success of students who are traditionally at greater risk of not accessing supports to succeed in college.

Concluding Remarks

Overall, our study provides a valuable contribution to the literature in showing the positive relationship between accommodation use and academic outcomes for students with disabilities. The use of a large, longitudinal database allowed us to portray the

demographic and accommodation use characteristics of students across disability types, building upon prior work. As the first known study to track accommodation use based on students' downloading of their accommodation letters each semester, we provide a more accurate depiction of students' actual accommodation use patterns over time. Participants in our sample were generally successful in college with regard to both GPA and graduation rates. However, students' academic outcomes varied based on gender, race/ethnicity, and disability type. Early registration with the disability service, and continued use of accommodations throughout college, was related to improved academic outcomes. Our within-subject analysis in particular provides strong evidence that early and consistent accommodation use, above and beyond any fixed individual factors, predicted incremental increases in GPA each semester. Though the findings must be replicated with additional samples, our study makes important headway in beginning to clarify the mixed evidence regarding the relation between service use and academic outcomes for students with disabilities.

In interpreting the findings of this work, it is vital to remember the underlying goal of postsecondary disability services. As described in chapter 2, the chief purpose of disability support services is to provide individuals with disabilities access to the educational environment. While academic benefits are certainly important, there are other meaningful ways that disability offices serve students in the college setting. For example, students in French's (2013) sample reported that the disability service not only contributed to their success in college, but also helped them develop self-advocacy skills; helped create a friendly learning environment; and helped students work through

problems with professors. Therefore, disability services play a larger role in students' success above and beyond tangible academic outcomes.

Individuals with disabilities have made huge strides over the past several decades at gaining increased access to— and visibility in— postsecondary institutions. Students with disabilities now make up over 11 percent of the student body at American colleges and universities (United States Government Accountability Office, 2009). Though they often face barriers related to knowledge of supports, self-advocacy skills, and disability stigma, students with disabilities are finding increased success in college. As disability services collaborate with university departments and other campus organizations to continue to increase awareness and decrease stigma, we are encouraged that students with disabilities can make even larger contributions to their postsecondary environments.

APPENDICES

Table 1

Description of Quantitative Research Questions

Regress-ion	Independent Variable	Dependent Variable	Comparison Type	Participant Description	*n*	Control Variables
2a	Delay to Register	Cumulative GPA	Between subjects	All participants	1979	Gender, Race/Ethnicity, Class, & Primary Disability
2b	Delay to Register	Months to Graduation	Between subjects	Participants who had graduated by August 31, 2019	825	Gender, Race/Ethnicity, Primary & Disability
3a	Length of Accomm. Use	Cumulative GPA	Between subjects	Participants who registered with ADS after June 1, 2015	1610	Gender, Race/Ethnicity, Class, & Primary Disability
3b	Length of Accomm. Use	Months to Graduation	Between subjects	Participants who registered with ADS after June 1, 2015 and had graduated by August 31, 2019	517	Gender, Race/Ethnicity, & Primary Disability
4	Accomm. Use Over Time	Semester GPA each semester	Within subjects	Participants who used accommodations for at least 3 semesters	1108	None (Fixed-Effects)

Table 2

Panel Data Example Showing Accommodation Use Across Semesters

Student	Semester	Accomm. Use? (0= no, 1= yes)	Semester of Accomm. Use	Semester GPA	Total Semesters Accomm. Use
Lee	Fall 2015	1	1	2.90	5
Lee	Spring 2016	1	2	2.75	5
Lee	Fall 2016	1	3	3.33	5
Lee	Spring 2017	1	4	3.56	5
Lee	Fall 2017	0	0	2.84	5
Lee	Spring 2018	1	5	3.33	5
Allyson	Fall 2016	0	0	3.30	3
Allyson	Spring 2017	0	0	3.60	3
Allyson	Fall 2017	1	1	3.56	3
Allyson	Spring 2018	0	0	3.20	3
Allyson	Fall 2018	1	2	3.58	3
Allyson	Spring 2019	1	3	3.69	3

Note: Participant names were created for illustration purposes and are not factual.

Table 3

Academic Outcomes Based on Demographic Characteristics

Demographic Characteristic	*n*	%	Mean Cumulative GPA	*n* Academic Probation/ Dismissal	*n* Graduated by fall 2019	Mean Months to Graduation
Female	1010	51.0	3.2	62	454	43.8
Male	970	49.0	3.0	110	372	45.7
Asian	149	7.5	3.0	15	52	46.2
Black/ African-American	173	8.7	2.7	39	73	47.7
Hispanic/ Latinx	187	9.4	3.0	15	89	46.3
Other	142	7.2	2.9	22	51	44.7
White	1329	67.1	3.2	81	561	43.9
ADHD	581	29.3	3.0	58	215	45.1
Brain Injury	31	1.6	3.3	1	16	41.4
Hearing	18	0.9	3.3	0	2	45.0
LD	287	14.5	3.2	21	123	42.7
Medical	168	8.5	3.3	10	49	46.8
Neurological	63	3.2	3.1	8	22	45.0
Other	173	8.7	3.1	13	113	44.2
Physical	50	2.5	3.3	2	27	41.2
Psychological	591	29.9	3.0	58	253	45.7
Vision	18	0.9	3.3	1	6	38.2
Total	**1980**	**100**	**3.10**	**170**	**826**	**44.7**

Note: Months to graduation was only calculated for students who had graduated by fall 2019.

Table 4

Games-Howell Pairwise Comparisons of Outcome Variables Based on Primary Disability Type

	Games-Howell Significance			
Primary Disability Comparisons	Total GPA	Months to Graduation	Delay to Register	Length of Accomm. Use
ADHD & LD	***	--	***	--
ADHD & Medical	***	--	--	***
ADHD & Neurological	--	--	--	--
ADHD & Other	--	--	**	***
ADHD & Physical	*	*	***	***
ADHD & Psychological	--	--	***	***
LD & Medical	--	--	***	***
LD & Neurological	--	--	--	--
LD & Other	--	--	***	***
LD & Physical	--	--	***	***
LD & Psychological	***	--	***	***
Medical & Neurological	**	--	--	--
Medical & Other	***	--	*	***
Medical & Physical	--	*	***	***
Medical & Psychological	***	--	***	--
Neurological & Other	--	--	***	***
Neurological & Physical	--	--	***	***
Neurological & Psychological	--	--	***	*
Other & Physical	--	--	--	--
Other & Psychological	--	--	***	***
Physical & Psychological	*	**	--	***

Note: ADHD= Attention-Deficit/ Hyperactivity Disorder; LD= Learning Disability. Students with Traumatic Brain Injuries, Vision disabilities, and students who are Deaf/ Hard of Hearing were not included in these comparisons due to small sample size. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 5

Games-Howell Pairwise Comparisons of Outcome Variables Based on Race/Ethnicity

	Games Howell Significance			
Race/ Ethnicity Comparisons	Total GPA	Months to Graduation	Delay to Register	Length of Accomm. Use
Asian & Black/ African-American	***	--	--	--
Asian & Hispanic/ Latinx	--	--	--	--
Asian & Other	--	--	*	--
Asian & White	***	--	***	--
Black/ African-American & Hispanic/ Latinx	***	--	--	--
Black/ African-American & Other	**	--	***	--
Black/ African-American & White	***	*	***	--
Hispanic/ Latinx & Other	--	--	--	--
Hispanic/ Latinx & White	***	--	***	--
Other & White	***	--	--	--

Note: * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 6

Student Cumulative and Semester GPAs by Semester of Accommodation Use

Semester of Accommodation Use	*n*	Mean Cumulative GPA	*SD*	Mean Semester GPA	*SD*
Semester 1	1802	3.06	0.60	2.89	1.00
Semester 2	1459	3.13	0.57	3.01	0.95
Semester 3	1092	3.15	0.52	3.04	0.93
Semester 4	778	3.2	0.50	3.11	0.91
Semester 5	512	3.23	0.49	3.16	0.91
Semester 6	297	3.28	0.46	3.25	0.90
Semester 7	146	3.21	0.50	3.15	0.96
Semester 8	65	3.21	0.51	3.26	0.92

Table 7

Accommodation Use Outcomes Based on Demographic Characteristics

Demographic Characteristic	*n*	%	Mean Length of Accomm. Use (in 6-month semesters)	Mean Delay to ADS Registration (in 6-month semesters)	Mean Number of Accommodations Approved
Female	1010	51.0	3.3	2.5	3.49
Male	970	49.0	3.2	2.3	3.41
ADHD	581	29.3	3.7	1.9	3.43
Brain Injury	31	1.6	2.5	3.0	2.90
Deaf or Hard of Hearing	18	0.9	2.7	0.7	3.17
Learning Disability	287	14.5	4.0	1.0	4.45
Medical	168	8.5	3.1	1.8	3.89
Neurological	63	3.2	3.9	1.4	4.51
Other	173	8.7	1.2	2.7	2.57
Physical	50	2.5	1.8	3.7	2.66
Psychological	591	29.9	3.1	3.6	3.04
Vision	18	0.9	4.3	0.6	5.72
Asian	149	7.5	3.1	3.4	3.22
Black/ African-American	173	8.7	3.0	3.6	3.42
Hispanic/ Latinx	187	9.4	3.3	2.9	3.26
Other	142	7.2	3.1	2.5	3.39
White/ Caucasian	1329	67.1	3.3	2.0	3.51
Total	**1980**	**100**	**3.23**	**2.37**	**3.45**

Table 8

Frequencies of Approved Accommodations by Accommodation Type

Accommodation Type	*n* Students Approved	**Accommodation Type**	*n* Students Approved
Test Accommodations		**Classroom Accommodations**	
Extended time on tests (1.5 time)	1389	Peer note takers	697
Computer on tests	336	Audio recording of lectures	493
Breaks during tests	286	Modification of course due dates	410
Extended time on tests (more than 1.5 time)	226	Modification of course attendance policies	377
Private testing space	195	Preferential Seating	275
Calculator on tests	129	Computer for note taking	249
Write directly on test (no scantron)	121	Breaks during class	160
Ability to take only one exam per day	111	Sign Language Interpreter	3
Total Students with Test Accommodations	1674	Total Students with Classroom Accommodations	1361
Adaptive Technology Accommodations	*n* Students Approved	**Program Accommodations**	*n* Students Approved
Alternate format of course materials	231	Priority registration	657
Screen reading software	123	Reduced course load	123
Adaptive technology software for exams	61	Campus Paratransit system	32
Note taking software	44		
Dictation software	16		
Total Students with Adaptive Technology Accommodations	289	Total Students with Program Accommodations	715

Table 9

Accommodation Approval by Primary Disability

Primary Disability	*n*	Test Accomm.	Classroom Accomm.	Program Accomm.	Adaptive Technology Accomm.
ADHD	581	95%	71%	38%	12%
Brain Injury	31	81%	65%	23%	10%
Hearing	18	39%	100%	11%	67%
LD	287	96%	64%	50%	39%
Medical	168	71%	88%	47%	5%
Neurological	63	89%	75%	44%	11%
Other	173	67%	49%	35%	15%
Physical	50	90%	48%	10%	10%
Psychological	591	74%	67%	26%	5%
Vision	18	94%	83%	50%	56%
Total Students Approved	1980	81%	68%	36%	15%

Note: ADHD= Attention Deficit Hyperactivity Disorder; LD= Learning Disability. Students who were approved for more than one accommodation type were counted under multiple categories.

Table 10

Chi-square Analysis of Approved Accommodations Based on primary Disability

		Accommodation Type			
Primary Disability		Test	Classroom	Program	Adaptive Technology
ADHD	Obs.	558	414	221	71
	Exp.	491	399	210	84
	Adj. Res.	**9.12**	1.56	1.15	-1.93
Brain Injury	Obs.	25	20	7	3
	Exp.	26.2	21	11	5
	Adj. Res.	-0.61	-0.5	-1.15	-0.78
Hearing	Obs.	7	18	2	12
	Exp.	15	12	7	3
	Adj. Res.	**-5.38**	**2.88**	-1.58	**6.29**
LD	Obs.	280	187	146	112
	Exp.	243	197	104	42
	Adj. Res.	**6.6**	-1.42	**5.63**	**12.68**
Medical	Obs.	120	147	80	9
	Exp.	142	115	61	25
	Adj. Res.	**-4.9**	**5.48**	**3.25**	**-3.55**
Neurological	Obs.	58	49	30	9
	Exp.	53	43	23	9
	Adj. Res.	1.7	1.57	1.93	-0.07
Other	Obs.	118	87	61	27
	Exp.	146	118.9	62	25
	Adj. Res.	**-6.2**	**-5.48**	-0.2	0.39
Physical	Obs.	45	24	5	5
	Exp.	42	34.37	18	7
	Adj. Res.	1.08	**-3.2**	**-3.89**	-0.93
Psychological	Obs.	446	400	154	31
	Exp.	500	406	213	86
	Adj. Res.	**-7.3**	-0.66	**-6.08**	**-7.69**
Vision	Obs.	17	15	9	10
	Exp.	15	12	7	3
	Adj. Res.	1.17	1.34	1.23	**4.94**

Note: ADHD= Attention Deficit Hyperactivity Disorder; LD= Learning Disability. Obs. = Number observed; Exp= Number expected; Adj. Res.= Adjusted Residual. Adjusted Residuals that exceed +/- 1.96 are bolded to denote significance of greater than 1 standard deviation difference.

Table 11

Linear Regression Analyses Prior to Entering Control Variables

Regr-ession	Independent Variable	Dependent Variable	*F*	*n*	*df*	Adjusted *R*-squared	*B*	Robust Standard Error	Constant
2a	Delay to Register	Cumulative GPA	120.36***	1,979	1,977	0.05	-0.06***	0.01	3.23***
2b	Delay to Register	Months to Graduation	128.91***	825	823	0.18	1.43***	0.13	39.97 ***
3a	Length of Accomm. Use	Cumulative GPA	74.88***	1,610	1,608	0.04	.06***	0.01	2.88***
3b	Length of Accomm. Use	Months to Graduation	8.44**	517	515	0.01	-0.45	0.15	45.76***

Note: * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 12

Multiple Regression Analyses of Delay to Register Use with Covariates

	Regression 2a: Cumulative GPA		**Regression 2b: Months to Graduation**	
	Beta	Standard Error	Beta	Standard Error
Delay to Register	-0.08***	0.01	1.53***	0.14
Male	-0.21***	0.02	2.48***	0.58
Black/African-American	-0.30***	0.06	1.35	1.51
Hispanic/ Latinx	-0.07	0.06	0.36	1.57
Other/ Not Reported	-0.07	0.07	-0.87	1.53
White	0.08	0.05	-0.37	1.15
Brain Injury	0.24***	0.08	-4.41***	1.42
Hearing	0.24	0.15	4.80*	2.23
LD	0.07*	0.04	-0.04	0.95
Medical	0.27***	0.04	1.41	1.56
Neurological	0.05	0.06	-0.06	2.10
Other/ Not Reported	0.04	0.05	-0.40	0.87
Physical	0.32***	0.06	-6.20***	1.34
Psychological	0.06	0.03	-1.50	0.81
Vision	0.11	0.15	-4.88	2.77
Sophomore	0.56***	0.09	N/A	
Junior	0.75***	0.09	N/A	
Senior	0.83***	0.09	N/A	
Graduated	1.01***	0.09	N/A	
Constant	2.50***	0.10	30.20***	
n	1978		825	
df	19.00		809	
F	44.85		12.85	
Adjusted *R*2	0.31		0.21	

Note: Reference categories: Female (gender); Asian (race/ethnicity); Freshman (class year); and ADHD (primary disability).
* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 13

Multiple Regression Analyses of Length of Accommodation Use with Covariates

	Regression 3a: Cumulative GPA		**Regression 3b: Months to Graduation**	
Predictor	Beta	Standard Error	Beta	Standard Error
Length of Accommodation Use	0.04***	(0.01)	-0.42**	(0.18)
Male	-0.22***	(0.03)	3.15***	(0.85)
Black/African-American	-0.26***	(0.07)	2.15	(2.15)
Hispanic/ Latinx	-0.01	(0.07)	-1.01	(2.32)
Other/ Not Reported	-0.02	(0.08)	-1.36	(2.32)
White	0.18***	(0.05)	-3.51**	(1.62)
Brain Injury	0.18**	(0.09)	-2.10	(1.73)
Hearing	0.36**	(0.15)		
LD	0.17***	(0.05)	-1.79	(1.70)
Medical	0.28***	(0.05)	0.59	(1.70)
Neurological	0.10	(0.07)	-3.00	(3.05)
Other/ Not Reported	0.12	(0.08)	-1.04	(1.81)
Physical	0.25***	(0.08)	-4.64***	(1.24)
Psychological	-0.06*	(0.04)	0.46	(1.06)
Vision	0.19	(0.19)	-14.65***	(4.39)
Sophomore	0.52***	(0.10)	N/A	
Junior	0.62***	(0.09)	N/A	
Senior	0.63***	(0.09)	N/A	
Graduated	0.77***	(0.09)	N/A	
Constant	2.31***	(0.11)	47.03***	(1.90)
n	1609		517	
df	1589		502	
F	24.63		4.61	
Adjusted *R*2	0.24		0.07	

Note: Reference categories: Female (gender); Asian (race/ethnicity); Freshman (class year); and ADHD (primary disability).
* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 14

Multilevel Model Regression of Length of Accommodation Use with Fixed Effects

	Regression 4: Semester GPA				
	Coefficient	Standard Error	*n*	*df*	*F*
Length of Accomm. Use	0.05 ***	0.01	1108	1107	3.96 ***
Constant	2.87 ***	0.02			

Note: * $p < .05$; ** $p < .01$; *** $p < .001$.

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